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Glass Plant Fuel Oil

By JOHN W. ROMIG [1]

FUEL oil as a fuel for kilns, glass tanks, glory holes, boots, pots, lehrs and other glass furnaces came into use as a result of—first, the failing production increase of natural gas particularly in the region east of the Mississippi River and second, the abundance of low priced fuel oil left over at oil refineries after the gasoline refining processes. Many glass plants have changed combustion chamber designs so that fuel oil readily replaces natural or other fuel gas. Fuel oil systems have been built up and equipment installed for the distribution of fuel oil to burners. In many cases the fuel oil system was designed and installed for the lighter fuel oils or distillates, which flow readily at low temperatures, rather than present day fuel oils. The improvements in gasoline refining together with the demand for distillate as a furnace oil has gradually decreased the supply of distillate with the result that the price of distillate is often high when compared to the price of more viscuous lower gravity petroleum fuels commonly left over after gasoline is removed.

In some plants now in operation fuel oil systems limit the viscosity or flow point specifications of fuel oil so that relatively light fuel oil or distillate must be used. The price differential between the lighter fuels and the lower gravity high viscosity fuel oils opens a field of fuel economics wherein the specifications must be limited because of fuel oil systems and their inadequacies, so consideration of alteration to existing equipment is in order. The economics of such changes are dependent upon the differential price of fuel oil of different grades, the quantities used, the applicability of low cost fuel to burner equipment and combustion conditions and the cost of alterations or additions to the fuel oil system. Research along lines of fuel oil specification and application may lead to handsome profits.

Fuel oil should be purchased on specification, but the specifications should not be made narrower than necessary or the possible sources of supply will be reduced. From a purchasing angle broad specifications are desirable; from the production point of view once a satisfactory brand of fuel is found the specification should be limited to include only the one source of supply or identical supplies. The specification that is wide enough to include fuels from several sources of supply and at the same time control oil quality so that production does not suffer allows a maximum purchasing range and attendant economies.

Rather than buying only on specification it is recommended that tests of trial cars of attractively priced fuel oils be made to develop supplies of satisfactory fuel oil. For instance, if a low pour test or a low viscosity fuel oil specification limits the purchasing field a car of fuel oil of low pour test or low viscosity may be purchased for test purposes. With an experimental fuel oil set-up the car may be tried in combustion chambers under actual production conditions after it has been heated to the proper temperature for handling and for atomization. A change in the fuel oil system may be required in order to take advantage of a fuel oil having the revised specification but the changes may pay well. Specifications without occasional investigations as to possibilities of changes are costly if allowed to remain fixed for long periods. A study of the market along with the specifications will reveal the advantages that may be obtained by fitting the fuel oil system and the specification to the fuel oil readily available at a low price. Figure No. 3 shows the relationship between gravity B.T.U. per pound and B.T.U. per gallon. A study will show that heavier oils contain more heat units per gallon.

There are some fuel oils that do not give sufficiently clean combustion for glass working. Instances encountered have shown that certain fuel oil characteristics cause luminous sparks to be thrown from the burner resulting in seeds and blisters if burned over glass in a working chamber. Water, free carbon, breaking down of the hydrocarbons, ash and residue content are common causes of incandescent bodies or sparks flying in a combustion chamber, but improper atomization will also give a similar result. Sparks from improper atomization however, can be controlled by correcting the burner conditions. Perfect atomization will not give clean combustion if the fuel oil is contaminated. Impingement of a portion of the discharge from a burner on refractories may also lead to fire troubles and carbon accumulations.

An example of specification limitation may be illustrated by the following incident. Fuel oil was being purchased on a rigid specification including weight Baumé, the oil supplied being somewhat heavier than distillate. The sup-

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ply of fuel within this classification became limited and the oil available was priced at a considerable premium over the heavier oils. Equipment was set up for testing quantities of fuel offered by vendors at a materially lower price. Several samples of heavier oil were investigated in the laboratory and results with some were quite pleasing. A car of the most attractively priced oil having a satisfactory test was placed on the tracks and the test equipment connected so that production was carried on for two or three days and results watched carefully. Samples from the car were taken, sealed and kept for references. No production difficulties were encountered during the tests and alterations were made to the fuel oil system so that it would handle a more viscuous oil. The alterations consisted of installing suitable fuel oil heaters in duplicate and providing a return loop system to the supply tank so that hot oil coursed through the entire system continuously.

If a fuel oil is attractively priced it is well to have samples analyzed in the laboratory prior to testing a car to study in particular the residue content. Tests of a car lot can be arranged with the vendor; as a rule the vendor will agree to allow return of the car of test oil if results are unsatisfactory, while if results are satisfactory, the oil may be kept. Testing of car lots is recommended in case of a change of fuel oil supply as a protection against filling oil storage tanks with unsuitable oil. Fig. No. 1 shows the test equipment for testing tank cars of fuel oil.

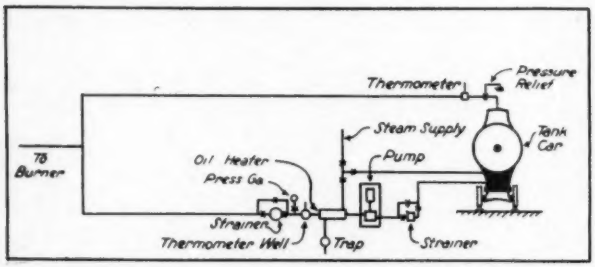

FIG. 1. TEST EQUIPMENT SET-UP—FOR CARLOT TESTING OF FUEL OIL
(*Elevation*)

Test equipment recommended is not expensive and is easy to set up. The itemized list of equipment and auxiliaries consists of:

1. A small pump—10 gpm. capacity (depending upon service) when discharging against the usual fuel oil pressure.
2. A heater—electric or steam, preferably steam. If steam, a steam trap is needed.
3. Steam pressure gauge and oil pressure gauge.
4. Strainers, before pump and after heater.
5. A thermometer well and thermometer. The thermometer should have a gauge from 0° to 400° F.
6. A fuel oil regulating valve to control from zero rate of flow to full flow.
7. A 50 gallon tank for small quantity tests.
8. Pipe, fittings and labor.

The entire collection of equipment may be mounted on a skid platform (Fig. No. 2) and made readily portable except for pipe and electric connections. The portable assembly may be used for either small or large test lots of oil. Cost of a complete set-up amounts to about $300.00 for equipment outside of piping. Labor cost of assembly is negligible in most instances.

In conducting a test the equipment is set up in a convenient location both as to the location of the car of fuel and the combustion chambers wherein the fuel is to be burned. The rotary or centrifugal pump (a piston pump may give undesirable pressure fluctuations if not properly installed and is more difficult to handle) is connected so it takes suction from the car after the water is drained out. The pump must be large enough to pump 30 to 50 per cent more than the burner requirements. A strainer should be in-

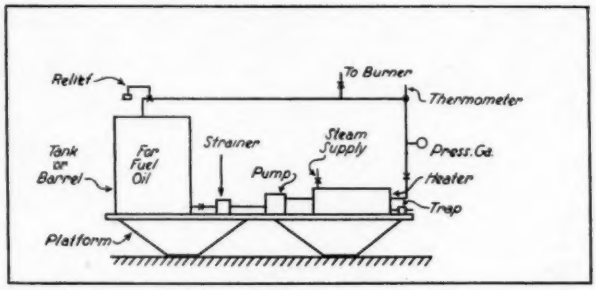

FIG. 2. PORTABLE TEST EQUIPMENT FOR TESTING SMALL LOTS

stalled on the pump suction to avoid pump trouble caused by solids which may be in the car. The oil heater (pressure type) is piped on the discharge of the pump as a pump handles oil better if the oil is not over 100° F. Next comes the thermometer well, a pressure gauge and then a fine mesh (about 100 mesh to the inch) strainer. The oil is piped from the strainer to the burners and a re-circulating loop is provided back to the manhole at the top of the car. The oil pressure regulating valve is located at the discharge into the car so that full pressure is kept in the oil supply line.

Usual procedure in making a test is to connect a steam supply to the steam coils in the tank car (a car with good steam coils should be specified) and heat the contents of the car to between 60° F. and 100° F. just so the oil flows readily. If the oil is heated too hot in the car it boils, gasifies and becomes a fire hazard.

The pump is started and the relief adjusted so that the proper oil pressure is secured. Steam is turned on and when run for a time to determine any faults everything is ready to connect the burners to the test supply. A double valved connection arrangement at the burners is desirable so first the usual oil may be used, then test oil, switching from one to the other as necessary or desired by merely opening and closing valves to the two supplies. Should the trial fuel be troublesome a minimum of interruption results with such a piping arrangement at the burners.

By varying the temperature of the oil and making observations of the conditions in the combustion chambers high and low fuel oil temperature limits for best operation may be determined. If a temperature above the gasification point is employed combustion becomes poor and if the temperature is too low atomization troubles are encountered. Pres-

sure changes may also be made and the most desirable pressure limits are thereby found during the test. Atomizing air or steam pressures may be varied to secure best results, burner adjustments may be made and the trial of different burners may be desirable during the course of testing. Data should be kept on results; pressures, temperatures and burner styles and sizes, etc., for each change in operation of the test equipment.

If after careful testing with varying conditions no satisfactory adjustment can be secured the test may be abandoned. However, if good operation is secured over a period of from 48 to 72 hours it is safe to assume that the test fuel can be applied and the test may be discontinued and the quantity of test oil remaining mixed with oil in storage. It is considered better procedure to test car lots of oil than to test small quantities such as a drum or two, for a car lot is a much more representative sample. The tests should be made on producing prints so that full information can be secured.

Assurance must be received, if an order is placed, that the vendor will supply a fuel of the same specifications as the fuel tested. His efforts along this line can be checked

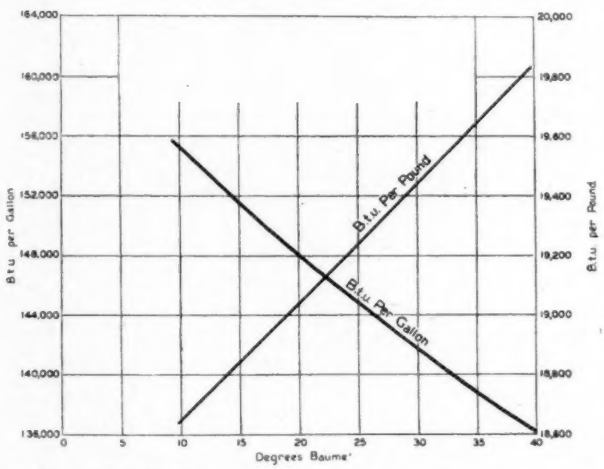

FIG. 3. VARIATION OF HEAT CONTENT OF FUEL OIL. DEGREES BAUME VS. B.T.U. PER GALLON AND DEGREES BAUME VS. B.T.U. PER POUND

by taking a sample from each car delivered and making simple analyses of the fuel before the car is emptied into the fuel oil storage. His failure to maintain uniform shipment should be met with rejection of fuel oil not coming within the specification agreed upon. It is often difficult for fuel oil jobbers to deliver fuel oil of certain specifications for extended periods of time as jobbers usually buy from several sources of supply. Uniformity of quality should be demanded for combustion troubles may result if large quantities of oils of several kinds are mixed together in the storage tanks.

The viscosity or flow point specifications are common limitations in the purchase of fuel oils. A further limitation that is mostly imaginary is the Baumé specification. It is believed by some that the weight Baumé has a distinct relation to viscosity or flow point; however, this belief is erroneous in many instances. There is a tendency for the heavier oils to contain more foreign matter, residue, etc., and this is important to control if clean combustion is to be secured.

Specifications of fuel oil should include sulphur content, B. S. & W. (bottom sediment and water, usually an emulsion with free carbon), grit or ash present, Sayboldt viscosity, flow point, flash point, weight in degrees Baumé and B.T.U. per pound. If the sulphur specification is more rigid than necessary the purchasing field is limited. Tests may be made with the above described test apparatus to determine limit on this specification. The B. S. & W. specification is important and the percentage should be kept low as dirty oil is always dangerous when used for glass working, one-half of one per cent is a usual figure for this specification. Viscosity and flow specifications are dependent upon whether or not hot oil can be delivered to the burners. If ample heater capacity is provided with loop fuel oil distribution piping well insulated and short branch lines this specification becomes quite flexible. Weight in degrees Baumé has very little value as a specification. The heat value B.T.U. per pound has little significance until it is combined with degrees Baumé so that B.T.U. per gallon may be calculated. Light fuel oils weigh less per gallon and even if the B.T.U. per pound is greater for a light oil the B.T.U. per gallon will be less than for a heavier oil for the weight per gallon is less. Fig. No. 3 mentioned previously shows a graphic comparison. Comparisons of heat content of fuel oils should be made on a basis of B.T.U. per gallon or barrel as that is the purchasing and shipping unit.

Fuel oil specifications not developed under actual operating conditions have a tendency to be too conservative and therefore handicap purchases of oil. Limitations determined under actual operating conditions making merchantable ware are much more satisfactory than those set arbitrarily or from information not developed in the field. The use of test equipment that will handle oils of various characteristics provides a safe and satisfactory method to determine what fuel properties are harmful to glass working in addition to eliminating from specifications properties that are not harmful. Such procedure will broaden the field of supply with all the attendant advantages, in price, delivery and quality of finished product.

Design and Mass Production

The manufacture of furniture, glass, pottery, etc., for the great public, must therefore cease to be a handicraft in industrial disguise—which it has been until now—and develop along the lines of true mass manufacturing such as the automobile industry, with few but good models—models which are the result of a close study of market conditions, technical processes, and new buying habits of the people. They must cease to be the speculative results of a muddling-through process.

From an article Design and Mass Production, written by Dr. Gregor Paulsson, director of the Swedish Arts and Crafts Society and published by the Design and Industries Association, London. —*In "Design in Industry"—Published by The Public Library and The Museum; Newark, N. J.*

Annual Meeting of Society of Glass Technology

AT the fifteenth annual meeting of the Society of Glass Technology held April 20 in Sheffield the following elections took place:

President, Edward Meigh, re-elected; vice-presidents, S. English, E. Jobling-Purser; ordinary members of council, Milton Asquith, Albyn Bunce, Arnold Cousen, A. E. Hill, J. B. Murgatroyd; Hon. Treasurers, general, D. P. Dudding, re-elected; American Treasurer, F. C. Flint, re-elected; Hon. Secretary, Professor W. E. S. Turner, re-elected.

The fifteenth annual report of the Council of the Society showed almost as many members on the roll at the end of 1931 as at the end of the previous year. Forty-three new members were elected, 22 being residents of foreign countries, 8 from the United States, 4 from Japan, 3 from Belgium, 2 each from Sweden and Italy and on each from Canada, China and India. Of the total number (661) of members on the roll, 367 are residents of the British Isles, 134 United States, 27 Germany, 24 France, 22 Japan, 13 Belgium, 11 Canada, 8 Russia, 6 Sweden, 5 China, 4 Czechoslovakia and the remainder scattered.

Included in the activities of the year, were visits to a number of glass works, laboratories, etc. In March a joint committee of glass manufacturers and pot makers under the chairmanship of Professor Turner was organized and succeeded in producing an agreed specification for pots suitable for the melting of English crystal glass. In May a delegation of about a dozen members met the Deutsche Glastechnische Gesellschaft at Frankfurt on Main. A series of works visits in Belgium and Germany had been arranged by Professor Turner, including a visit to Jena to meet Dr. Otto Schott.

The Society also took the initiative in an effort to increase the interest of the Glass Division of the American Ceramic Society in cooperating with the Deutsche Glastechnische Gesellschaft and the Society in formulating agreed standards. A very successful exhibition of modern technical and artistic glasses was held in the Science Museum, South Kensington, opening on October 31, 1931, and continuing until January 10, 1932. A series of weekly lectures on a variety of topics attracted large attendances.

During the year the Third Report on Progress of Glass Technology prepared under the auspices of the Glass Research Association Trust Fund was presented by Dr. J. T. Littleton. Invitations were issued also to Drs. S. English, J. S. Partridge and G. W. Morey to prepare reports on specified subjects, also under the G. R. A. Trust. A subcommittee consisting of Professor Turner, W. Butterworth, Jr., and G. S. Duncan has had under consideration with the Deutsche Glastechnische Gesellschaft and the British Society for International Bibliography, a plan for the bibliographical classification of glass technological literature. The general income and expenditure account showed a very satisfactory condition, there being only a very slight deficit, less than £2.

In the program of the Sheffield meeting held April 11 there appeared a notice referring to the recently issued Glastechnische Tabellen (reviewed in the Society Journal of December, 1931.) to the effect that the publishers have agreed to offer the volume at a reduced price to members of the Society provided at least 30 copies are ordered simultaneously. The ordinary price is 149.80 marks. The special price offered under the above arrangement is 20% less—119.80 marks. Members desirous of taking advantage of the above offer are asked to notify Professor Turner at Sheffield not later than May 31.

London Section

On Wednesday, April 6th, members of the London Section of the Society of Glass Technology listened to a very interesting discourse by Mr. Bernard F. Dudding, M. B. E., A. R. C. S., F. Inst. F., on "Statistical Methods of Handling Test Results, with special reference to the Testing of Glassware." The meeting, which closed the 1931-1932 session, was held in the Science Museum under the chairmanship of Colonel S. C. Hales, C. M. G.

In spite of the fact that the subject was of a mathematical nature Mr. Dudding explained it in such a way that all those present could not fail to derive benefit from it. The theory differs from that usually dealt with in the standard books on statistics and has been developed by Mr. J. W. Rhyde, one of Mr. Dudding's colleagues, who hopes to publish it shortly.

Not only did Mr. Dudding show the application of the theory to his particular work of testing electric lamps but, by means of curves, he demonstrated how it could be applied to the results of tests of glass bottles or any other ware. In the discussion which followed, the author was able to elucidate the theory still further when replying to questions asked by Dr. S. English, Mr. E. Weigh and Mr. W. J. A. Warren.

Following a vote of thanks proposed by the Chairman, the members were reminded that the Annual Dinner of the Society would be held on Wednesday, May 25th at the Trocadero Restaurant and that the London Section would visit the Queenborough Works at the invitation of the Canning Town Glass Works, Ltd., on some Sunday in June. Members were also asked to assist the President and Council in their endeavours to increase the membership of the Society. A special endeavour is being made to bring the number of members up to 700 in the current year.

MARCH MEETING

The 142nd meeting of the Society of Glass Technology was held in Birmingham on March 16, 1932. Three papers were presented.

(a) THE REACTION BETWEEN CALCIUM CARBONATE AND SILICA, by W. Maskill, B.Sc., G. H. Whiting, B.A., Ph.D., and Professor W. E. S. Turner.

In his introductory remarks, Professor Turner referred to the work reported in an earlier paper, dealing with the reaction between sodium carbonate and silica. The aim of the present work had been to investigate the reaction bebetween calcium carbonate and silica of definite, small grain

size, at various temperatures, the substances used being pure, in the form of calcite and crushed rock crystal.

It was found that, at 700°, the decomposition of calcium carbonate was accelerated by the addition of silica, the acceleration increasing when the proportion of silica was increased from one to three molecules per molecule of calcium carbonate. At 750°, and 800°, however, the addition of silica in the proportion of SiO_2:$CaCO_3$, produced very little change, although, as the silica content of the mixtures was increased, acceleration took place. Analysis showed that very little reaction had taken place between the carbonate and silica at these temperatures.

It was obvious, from the results obtained, that this acceleration was not due to increased chemical activity, but to a physical effect. The silica diluted the calcum carbonate, allowing of a quicker diffusion of carbon dioxide, and hence aiding the decomposition.

The mixtures were analyzed chemically after the heating treatment, the method of analysis being described in some detail.

It appeared that, at 800°, about 4% reaction had occurred, between the silica and the carbonate; the value at 1050° was 10%; while the reaction was almost complete at 1400°-1450°.

Turning to a consideration of the actual behavior of silica and limestone in a glass batch, the Professor showed that, from this research, it was evident that the calcium carbonate was split up, or decomposed primarily by heat alone.

(b) THE EFFECT OF GAS ON A COMMERCIAL GLASS CONTAINING LEAD OXIDE, by J. H. Partridge, B.Sc., Ph.D.

(Communication from the staff of the Research Laboratories of the General Electric Co., Ltd., Wembley.)

Dr. Partridge described how the surface of a commercial lead oxide glass (30% PbO; 56% SiO_2) soon lost the mirror-like appearance when exposed to the atmosphere existing in an oil fired tank furnace at 1200°. In two or three weeks' time the glass became cordy and lumpy, and the surface was dull, with small lumps of a white substance sometimes present. The white deposit was found to be mainly cristobalite. The application of heat alone at the temperatures concerned did not cause this precipitation, and the only gas which had any visible effect on the glass was sulphur dioxide.

At a temperature of 1200° in special experiments, this gas caused separation of silica on the glass surface, identical in crystalline form with that obtained in the tank, but in presence of oxygen, a complex mixture of the sulphates of the alkalies and lead separated out with the silica. The atmosphere from burning fuel oil containing 1.7% sulphur also gave this result, which, however, was less marked when paraffin with only 0.04% of sulphur was used instead of the fuel oil. It was found, when trying to achieve a greater stability of the glass in presence of sulphur dioxide, that the addition of a small amount of boric oxide rendered the glass more resistant than the parent glass.

The speaker stated that he had discussed these results with Professor Parmelee of the University of Illinois, who had observed a somewhat similar phenomenon in the case of enamels. Professor Parmelee had not been able to identify the composition of the surface film but he detected sulphur in the enamel, and Dr. Partridge, as a result of this suggestion, had found sulphur in the surface deposit on one of the glasses studied. Possible theories to explain the action of sulphur dioxide were discussed.

The author expressed his thanks to his colleague, Mr. H. P. Rooksby, S.Sc., who detected cristobalite in the surface films on the glasses.

(c) VOLATILIZATION FROM POTASH LEAD OXIDE GLASSES AND ITS BEARING ON THE CORROSION OF GLASS MELTING POTS, by E. Preston, B.Sc., and Professor W. E. S. Turner.

The process of volatilization from the surface of a molten lead glass, initially homogeneous, had been studied. The influence of temperature and time upon the progress of volatilization was shown in tabular and graphical form over a range temperature 900° to 1400°, and for times extending to 200 hours. It was shown that volatilization of the volatile constituents of a glass took place in a manner similar to simple evaporation, the rate of volatilization at any time being proportional to the partial pressure of the volatilizing constituent or constituents. This fact was directly proved over the range 1100°→1350° by actual determinations of the vapor tensions of the volatilizing material, by the dynamic inert gas method, and by utilizing the previous information, the scale of vapor pressures of the volatilizing PbO in this glass was extended from 0.005 m.m.Hg. at 900° to 6.50 m.m.Hg. at 1400°.

The bearing of the work upon the corrosion of glass house pots used for melting full crystal glass was discussed. The results of tests upon the crown and jib of corroded pot samples showed that the slagged interior surface of these samples were rich in PbO and K_2O. Penetration of lead oxide and potash into the refractory took place to a slight extent. It was suggested that high temperature firing of the pot as a whole, provided the refractory was suitable, might offer a partial remedy by reducing porosity and increasing the resistance to the slagging action of the lead oxide and potash vapors.

Information was furnished concerning a melt of this lead glass held in a cylindrical slip-cast crucible for 100 hours at 1350° C. Resulting analyses of sections of the glass showed the establishment of a concentration gradient of PbO from approximately 30% PbO at the bottom of the pot to less than 15% PbO at the upper surface, due to simultaneous volatilization and diffusion of the PbO. This showed once more that a uniform temperature distribution was a factor entirely opposed to the production of homogeneous glass when volatile constituents were present such as PbO, K_2O and Na_2O.

The Aluminum Seal Company of America, a division of the Aluminum Company of America, recently announced through J. E. Sharp, vice-president, the formation of a market research committee designed to provide a special and more direct type of service in developing the best type of closures for glass containers. Five men, widely experienced in this line whose combined experience totals 84 years of technical and practical work in the cap and seal industry, will be put at the service of the manufacturers and distributors of food products.

The Manufacture of Rolled Plate

By ERNST LUTZ*

This work has been revised, so far as the English and the technical expressions are concerned, by F. W. Preston, who has also added a number of notes relating in general to the special conditions of American practice; but it must be understood that the opinions expressed in the text are those of Mr. Lutz, and neither the Editor nor Dr. Preston accepts responsibility for them.

(*Continued from the April, 1932, issue*)

EXPERIMENTS AND NEW METHODS OF MANUFACTURING THIN AND STANDARD ROLLED PLATE GLASS

IN the old-fashioned way rough plate glass is rolled down to $\frac{7}{16}$" to ½" and its thickness further reduced down to ¼" to $\frac{5}{16}$" by grinding on both sides. For many applications it is the main requirement that a certain minimum thickness should be maintained (see United States Government Specification for Flat Glass for Glazing Purpose; Federal Specifications Board, Specification No. 123; section for polished plate glass).

Extensive beveling with sharp effects can only be realized with thicker sheets and on mirrors; in thin sheets they become too small or when made wider get too flat and unimpressive.

However for many purposes thinner plate glass at all times was demanded partly on account of its lower weight and the easier framing, and partly on account of cheapness. In particular for furniture which was not subject to severe treatment, sheets of under $\frac{3}{16}$" were almost exclusively used. For such applications very often blown glass, mainly the best semi-white glass, was preferred, the more so as smaller sheets alone come into consideration. During the last 20 years cast plate glass of small thickness has successfully entered this field; at first, naturally, only in the boundary range between thin and thick glass, i.e., in the thickness of $\frac{3}{16}$ and 7/32", which was used mostly for wind-shields, car windows and the like. Later, however, rolled plate glass, ground and polished, was also supplied in thicknesses down to 0.090". During the last decade it was especially the gigantic demand of the automobile industry that made for great changes in manufacturing methods.

As the preceding chapters have shown, the plan exclusively used for the large plate glass factories is laid out solely for the mass production of plate glass sheets of standard thickness. The melting pots for one factory generally speaking are all of equal size; their content corresponding with the size of the casting table and with the dimensions of the annealing lehr. The size of the rolled sheets bears a definite relation to a certain *minimum* rough glass thickness, which with the usual machinery is 13/32" and in exceptional cases ⅜"; in the majority of factories an average of about $\frac{7}{16}$" has to be reckoned with. With these old established methods it was not possible to produce continuously thin sheets and fully utilize the machinery or to convey the sheets in time into the annealing kiln. In order to produce thinner rough glass, the rough sheets would have had to be rolled shorter and the dimensions of casting table and annealing kilns would be only partially utilized. But the smaller the surface of the rough sheet, the higher are the shop costs per square foot of rough glass; the thin rough plate glass would therefore become more expensive than the ordinary one. It must also be borne in mind that each departure from the ordinary working cycle means severe interruptions in the run of the melting furnaces and the annealing ovens. To meet the demand for polished glass of less than $\frac{3}{16}$" thickness, large cast plate glass factories preferred simply to grind the ordinary rough glass somewhat longer; the shop costs thereby increased less and the run of the factory was less disturbed. For this thinner cast plate glass, corresponding to the higher shop costs, a higher price was asked than for glass of standard thickness; these prices were paid on the market because the blown ground and polished glass, when thicker than ⅛" could be obtained in small sizes only.

The ever-increasing demand for thin plate glass, the drawbacks of blowing, and the high shop costs of thin glass produced by an extended grinding of the ordinary plate glass, called for a better way of producing it. The manufacturers of best semi-white glass as well as those of cast plate glass for a long time gave thought to such improvements, and on both sides suggestions were tried out. It is no great surprise that with the blowing process, no success worth speaking of was realized; apart from the real drawing methods there is known no other machine-blowing or blowing and drawing method of any significance to the plate glass market

ROLLED PLATE GLASS FROM SMALL POTS

Of particular interest is the method where the glass is melted in pot furnaces with small pots and then cast and annealed, similarly to thick cast plate glass.

This method was no longer hindered by technical difficulties as soon as it became possible to remove the thin sheets in time into the annealing kiln and as soon as these kilns were designed in the form of the present lehrs. In cases were difficulties arise in removing the sheets from the casting table into the lehr before they distort and warp, the German Patent 334,700 of December 11th, 1914 (Jul. Bauer in Neustandt an d. Waldnaab and Verein Deutscher Spiegelglassfabriken G.m.b.H. in Köln) suggests re-heating them in a separate first chamber of the lehr provided with a flat bottom, so that it adapts itself therein to the bottom and can

*Of Desseau, Germany. This work is appearing in German in the new edition of *Dralle-Keppeler*, "Die Glasfabrikation."

FOOTNOTE: In the Figures, originally prepared for use eventually in the new edition in the German language of *Dralle-Keppeler*, "Die Glasfabrikation" in 1931, dimensions are given in metres (*m*) and millimetres (*mm*). We would like to have given these in feet and inches but the translation and the making of nearly two hundred and fifty new illustrations would have involved a prohibitive loss of time and expense. To some of our readers the metric system is as familiar as the English units; for the others we may say that a metre is approximately 40 inches, and a millimetre is approximately 1/25 of an inch. A thousand millimetres, of course, go to a metre—F. W. P.

be flattened. It has, however, not become known whether this suggestion has actually been carried out in practice. Economy with the casting process with small pots had to be attained by the best possible utilization of existing machinery. In the meantime, these new methods as, e.g., the one of the Pittsburgh Plate Glass Co. and the Bicheroux System have brought forth such tremendous advantages that the operation with small pots will be of no significance whatever for the future. However, the above descriptions will be of general interest so far as the operation of pot furnaces and the rolling of thin glass on casting tables is concerned. For this reason and in order to make the description of the development and of the experiments complete these descriptions are retained in the new edition of Dralle-Keppeler "Die Glasfabrikation."

Several manufacturers of best semi-white glass therefore employed ways entirely new to them by producing thin rough glass plates out of small melting pots or by dipping out of a tank furnace. The experiments were applied sometimes to rolling on stationary tables, sometimes in the Chance-mill. As far as the scooping out from a tank was concerned the difficulty lay in the quality. In the beginning there seemed to be no way of avoiding the excessive formation of strings and especially of bubbles. These difficulties, however, have been overcome quite satisfactorily and one may anticipate that a sufficient output of first quality plate glass will be obtained if appropriate furnaces are constructed and the furnaces can be attended in a suitable way. By means of mechanical scoops already sheets of 5 ft. width and 15 ft. length can be produced.* Increasing experience will undoubtedly bring further progress.

Some manufacturers of cast plate glass worked with a view to continuing production with those melting pots that were in use up to that time, but rolling their contents in a more practical way than before. From what follows one may see that no little success was achieved in that way. Others beginning with experiments on the tank furnace have made substantial progress towards results which previously were not thought possible.

All this shows that the aim of the first efforts was merely to meet the demand of that time for thin plate glass by more economical methods, or, in other words to eliminate the blown best semi-white glass and the thin glass produced by extended grinding. The increased demand arising later from the automobile industry and making these developments a matter of urgency called for sheets of only comparatively small dimensions and of a thickness below the old-time standards. All these efforts led to achievements greater than originally intended, for the result was that some of these methods are nowadays used to manufacture plate glass of normal thickness and of large area in a more profitable way than the old methods.

In this connection we may finally repeat that manufacturers of drawn glass also have succeeded, in singling out a considerable part of their production for grinding-polishing, i.e., as a quality of glass that can be put on the market for plate. As its name indicates, this glass must be ground and polished in order to meet the requirements of plate glass.

Of course, here again one square foot of rough glass will be the cheaper the larger the rolled plate, i.e., the larger the small pots. From this point of view the size of the pots should be so chosen that it is just possible, to get the thinnest rough glass sheet in time into the lehr. On the other hand the tendency must be to cast as frequently as possible, i.e., to do the work in the melting furnace in as little time as possible so as to reduce wages, material and general costs per cast. The smaller the pots, the shorter will be the time for melting, refining and moderate fire. For the time being it has become customary to cast every 12 hours as compared with every 24 hours with the thick plate glass.

In fact, even a very rough comparison shows that, given good furnaces and effective rolling and annealing, this cycle is quite able to maintain its position beside the old one with the large pots. With real skill on the part of the workmen it is possible to continuously roll on iron casting tables rough glass plates of about 16½′ length, 13′ width and 0.280″ to 0.300″ thickness and to push them in time into the lehr. Per pot, on an average approximately 162 sq. ft. of squared rough glass sheets ready for grinding and polishing are obtained. The glass quantity rolled into such a plate is about 5⅔ cu. ft. the quantity actually contained in the pot before casting about 8⅘ cu. ft., while the maximum capacity of the pot amounts to 12⅓ cu. ft. The plate glass factories working with machinery of the size No. I, referred to previously and producing plate glass of standard thickness are daily getting one casting per pot and manage to do the furnace work comfortably in time; factories working with machinery size No. III on the other hand, have difficulty in casting every 24 hours. Pots of size No. I which yield per cast about 237 sq. ft. of squared rough glass sheets, give a quantity of glass for rolling of about 10½ cu. ft., the actual mass of molten glass is approximately 16¼ cu. ft.; the pots of size No. III yield 18⅓ cu. ft. and contain 30 cu. ft. No. I therefore contains almost double and the pot No. III more than three times the quantity of the small pots. It should therefore be easily possible to manage with these smaller pots two castings in 24 hours; this all the more as the small pots have thinner walls and consequently a more favorable heat transmission. On the other hand the heating and annealing effect of the surface in ratio to the pot contents is the same in both cases. The small pots can also be more pushed in the refining than the larger ones.

If a 16-pot melting furnace of size No. 1 daily produces $16 \times 237 = 3{,}792$ sq. ft. of rough glass of ⅜ to 7/16″ thickness, ready for grinding; a furnace with 16 smaller pots yields daily $2 \times 16 \times 162 = 5{,}180$ sq. ft. of ready cut rough glass of 0.280 to 0.320″ thickness. Providing that in both cases furnaces with 16 pots are used, the fuel consumption, during 24 hours, will evidently be about the same, also the fuel consumption for the annealing kilns will not differ appreciably; the thin rough glass sheet naturally will bring somewhat less heat into the annealing kiln than a thicker and larger one; on the other hand, due to about double the number of sheets, the smaller annealing

*The wire glass manufacturers in America produce sheets of this size by hand dipping.—F. W. P.

kiln will run more continuously and its radiation losses will be smaller than with the large one. With otherwise the same conditions it may be assumed that the annual expenses for the melting furnaces are about the same in either case, the same applies to the expenditure for light and power, repair and maintenance, for auxiliary materials (cleaning, lubrication) as well as for the general overhead costs inclusive of wages and salaries. The costs of batch material per one sq. ft. of rough glass, stand in the ratio of the sheet thicknesses. With thin glass the monthly wages are about 30% higher than with thick one, because two instead of one casting-and-cutting-gangs are required; however, in the former case every one of these two gangs has a smaller number of workmen than the one for the thick glass. The costs of the whole plant, and with it the annual depreciation for a rough glass factory with, for instance, two melting furnaces, are approximately 30% lower with the thin glass than with thick one.

In spite of the fact that polished plate glass of greater thickness, due to the greater average size of the sheets, commands a higher sales price than the thin glass, the above comparison shows that the method described for small pots, when utilizing the machinery fully, is certainly competitive. It must be borne in mind that, if required, polished sheets of 0.15″ to 0.20″ thickness in this way can be produced up to 130 sq. ft. surface.

The competition of blown glass only became significant in the case of sheets of small thickness, because in this respect the method with small pots and metallic casting tables has its limitations. On account of the contact with the metallic casting table and with the roll, the glass skin is suddenly cooled; if the sheet is sufficiently thick its core will be able to supply sufficient heat to the skin, so that the latter still remains elastic under the rolling pressure. However, if the core is too thin, the skin will remain rigid, i. e., the thinner the sheet is rolled, the greater must be the specific rolling pressure in order to squeeze the glass down to the small thickness required. From a certain sheet thickness on downwards, the rough glass skin will remain so stiff that it is no longer elastic and cannot resist the pressure of the rolls; in such a case the skin will crack in a greater number of places and be quite covered with cooling cracks or chills. The colder the glass when casting, the greater is its liability to crack. On the other hand, a certain maximum temperature of the glass mass cannot be transgressed, as otherwise the quality of the glass will suffer.

Even with sheet thickness of 3/8 to 7/16″ (apart from the behavior of the sheet head which is formed by the colder layers of the glass mass in the melting pot), the other part also of the sheet is apt to show more or less cracks; the depth of these latter is, however, so small that they are insignificant. With a sheet thickness of 0.280 to 0.320″ these cracks are of such magnitude that with the usual grinding they just disappear with the rough glass skin. When rolling the sheet thinner the cracks go into the interior of the glass, consequently they can only be got rid of by a prolonged grinding with a corresponding reduced sheet thickness. Up to now it has not been possible to build sufficiently large casting tables of a poor heat conductor to prevent the chilling of the rough glass skin. Tests in this connection failed on account of the inability of the surface of the materials that were tried to withstand the high pressure of the roll, or the temperature of the glass heap, and also due to the fact that the glass in parts stuck so tightly that, in cooling down, parts of the surface were torn off or the sheet did not come off the table; further, it was not possible to design larger tables which, in time, did not show distortion.

It may be assumed that the said drawbacks forbid the continuous production of rough plate glass sheets below 0.300″ by rolling on metallic casting tables. In exceptional cases it may be possible without any reduction of quality to produce, with very hot glass, sheets of below 0.300″ in which the depth of the small cracks or "checks" is insufficient to do any harm. However, thinner glass will always require an extended grinding, so that its competition with blown semi-white glass was becoming more and more difficult and finally impossible when the thickness of the finished plate glass falls below 0.140″. Even if the demand for plate glass, which for technical reasons must be thinner than 0.140″, is not decisive, the thinner glass for small sheets is very often preferred on account of its lower price. It is for this reason that the casting method, with small pots and small tables, was not able to replace the old best semi-white glass altogether.

Some Bavarian glass factories for that reason set out successfully to roll the thin glass in Chance mills, as used for figured glass and the like. In such a mill the glass mass is not so long in touch with the iron as when laying on the casting table, and the glass can be rolled appreciably thinner without the above-mentioned drawbacks arising.

But this method has not been developed either, for the systems described below have proved superior.

System Employed by the Pittsburgh Plate Glass Company

The last mentioned idea in connection with the problem of employing large pots has become more significant through the patented Showers process of the Pittsburgh Plate Glass Co. In this the lower roll is made as a hollow cylinder of about 140 inches diameter and of relatively small width. The usual casting table is, so to speak, bent over into a cylinder and turns in this form with the top-roll. (See *Fig.* 211 *a to* 211 *c.*) The sheet produced in such a way slides over the guide rolls directly into the annealing oven. It is therefore possible to produce long glass sheets out of large pots. (See U. S. patent specification 1,579,666.)

The cylinder, i. e., the lower and larger roll, rests upon two supporting rolls 7 and 8, one of which is driven in order to make the cylinder rotate. The top roll is also driven by the same supporting roll by means of a cog-wheel. The bearings of the top roll can be adjustably swung around the axis of the supporting roll 8 and the space between the axis of the top roll and the axis of the supporting roll can also be adjusted in the swinging levers. An essential feature is that both the supporting roll that is driven and the top roll lie on approximately the same radius of the cylinder in order to keep the glass thickness constant.

So far as the forming of the glass plate is concerned, this system is different from the table system in that the base moves, while the axis of the top roll does not move, during

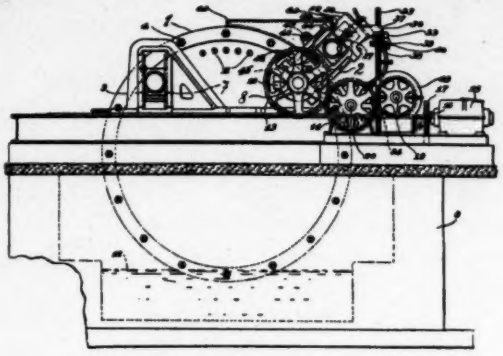

FIG. 211a

the rolling process. After all, however, the treatment of the glass mass does not differ.

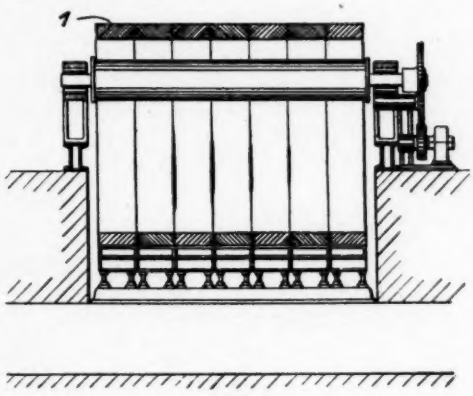

FIG. 211b

The cylinder is composed of several rings just the same as the even table is composed of several segments. Because of the ring form, the cylinder warps less in the heat

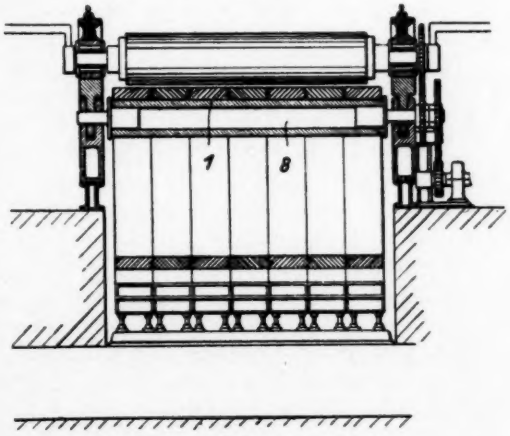

FIG. 211c

than the even table would do. Below, the cylinder dips into a cooling basin; the top roll is cooled by water circulation. To prevent lateral flowing down of the heaped up glass mass, the walls 44 rest on the cylinder and lie against the front surfaces of the top roll; the walls 44 are pressed against these front surfaces by means of springs so that they permit a good closing without abrading the circumference of the top roll as would the sliding shoes or guns of figures 67—69 in the table system.

This method was not practicable for the larger melting pots until there were available successful lehrs for long plates in the form of ribbons. As before stated, lehrs of that kind are successfully used in connection with other rolling machines.

Before these lehrs were used for plate glass, there was no way of pushing the long sheets of thin rough glass as a whole in time into the lehr. This still applies to the numerous cases where those lehrs have not been adopted for various reasons. In consequence, as the following remarks show, the methods of meeting these difficulties have already been found.

For that reason, according to the U. S. A. patents No. 1,090,904 and 1,101,392 of Max Bicheroux of Herzogenrath, Germany, the sheet in the course of rolling is cut into a number of smaller parts, so that the first rolled sections can be inserted into the lehr before the last ones are completely rolled. The separation of the various sections is intended to take place immediately behind the moving roll, so that the sheet between two cuts can be removed as quickly as possible into the lehr. Of course, in such a case the casting table would become so long that it could hardly be formed by one single table. The said specifications, therefore, make provision to build the table up of a number of smaller tables in series and to separate the sheet at the points where the tables join. These smaller tables at the same time have the advantage, that their surface can more easily be made plane, and kept plane, than those of the usual large size; the smaller ones distort less and their cooling can be controlled more accurately.

Figs. 1 and 2 of the specification 1,090,904 refer to a great number of very short tables and Figs. 212 and 213 show a design as actually suggested. It was the evident intention to use 6 tables 1 — 6, of which the first and the last one would serve for the setting of the roll and the movable knife w, as well as for the head and end piece of the sheet to be cut off. The four water-cooled main tables 2 — 4 were intended to be about 13⅛′ long and 14¾′ wide. In between two tables a clearance was provided which, during rolling, should be filled up by a water-cooled cast iron segment. This segment, immediately after the passing of the roll, was intended to drop automatically in order to give clearance to the knife following the roll and cutting the sheet. With a total length of the glass sheet of 54½′, a width of 13⅛′ and an average rough glass thickness of 0.295″, the glass mass rolled out was approximately 17⅔ cub. ft. Pots as usually employed for thick plate glass plants of the size No. II would meet this case.

Figs. 214 and 215 show the test arrangement, which proved the feasibility of the idea, and of rolling the great glass heap into such a long sheet. In the first instance only the behavior of the glass mass at the beginning and at the end was to be studied; in the tests the two middle tables were therefore replaced by an existing old table 3, which had to take up a corresponding amount of glass. Only the tables

2 and 3 were built to the new design and to the dimensions proposed. The apprehension that before the finish of the rolling process the glass mass would become too stiff proved to be unjustified. As known, the hot core of the heap poured in front of the roll forms the end of the sheet and this, with the usual sheet length is its softest part. Even in the pro-

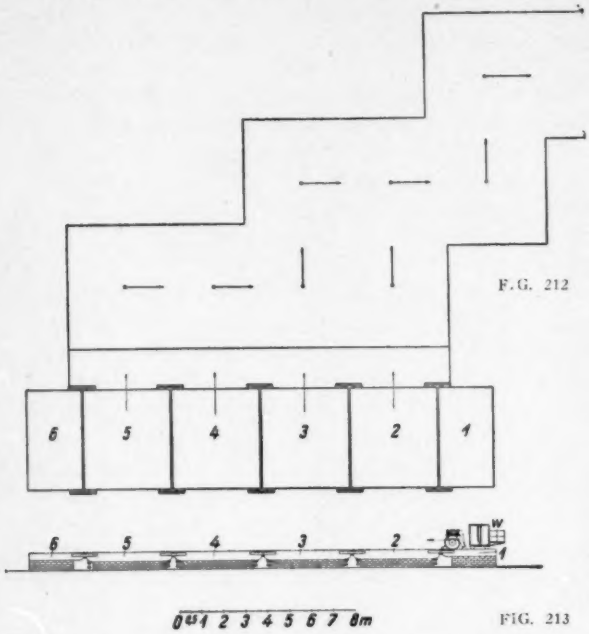

FIG. 212

FIG. 213

duction of a much longer and thinner glass sheet the core maintained such a temperature that the end of the sheet remained softest. From this fact it could be inferred that the behavior of the glass mass is such that still longer sheets could be rolled. At the same time the roll, on account of its heavy weight and in order not to impair the quality of the

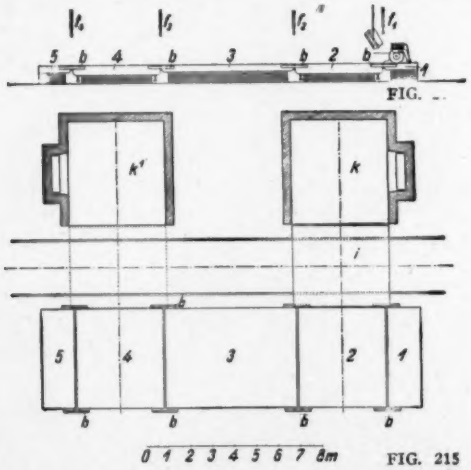

FIG. 215

sheet, was drawn over the table more slowly than usual; its horizontal movement was 6 — 8″ per second as against 9 — 11″ per second in the rolling of ⅜ — $\frac{7}{16}$″ thick sheets.

In these tests the glass thickness was fixed by two rings fitted on the ends of the roll; the usual "trams" would have hindered the sidewise removal of the sheets. This arrangement, as a matter of fact, has not shown any disadvantages. For passing the roll over the clearance of 2″ in between two tables, and in order to avoid excessive pressure on the inserted segments, the tables were connected with each other by bridges b, on which the collars m (Figs. 216 and 217) ran. These collars further served as flanges and counter-

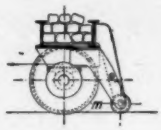

FIG. 216

FIG. 218

acted the tendency of the roll to run untrue. The bridges b had to be so fitted to the tables, that they could follow the dilatation of the latter. As stated in an earlier section, the specific pressure on the glass mass must be the higher, the thinner the sheet is to be. For the stretching of the glass down to a sheet thickness of ⅜ — $\frac{7}{16}$″ and with a roll diameter of about 24″, a roll weight of 1,350 lbs. per 1 foot of sheet width is just sufficient to ensure that the glass mass is sufficiently pressed down to keep the roll everywhere in contact with the trams and to avoid its floating on the glass, causing locally increased thickness. A roll of 24″ diameter just fulfills this condition, but is not enough for a sheet thickness of 0.280 — 0.320″. In the tests the roll had therefore to be loaded up (see Figs. 216 and 217). Only after the total pressure reached 40,000 lbs., i.e., with a sheet width of 13⅛′, 3,050 lbs. per foot, were the roller rings p in continuous contact with the table and the uniformity of the glass sheet uninfluenced by lifting of the roll. The coupling in series of two rolls has not proved successful, as in between the rolls the still soft glass is jammed up, and in front of the second roll a high glass wave is formed leaving wrinkles in the sheet, which very often enclose impurities; further, the glass thickness was less uniform than with an arrange-

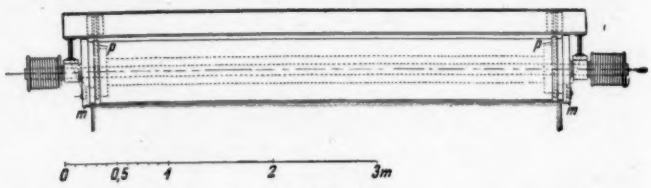

FIG. 217

ment as shown in Figs. 216 and 217; finally the second roll required so much space behind the first one that it took too long a time until it passed the table junctions and the knife f for the cutting of the sheet could operate.

During these tests the sheets were brought from the tables 2 to 4 over a light wooden intermediate table i into the single chamber annealing kilns k and k_1 (Fig. 215). The intermediate table i could be removed by hand on rails. A number of possibilities for combining a final equipment with lehrs is given in the German Patent No. 332,303, see also the U. S. A. patent specification 1,175,116, Fig. 1.

The separation of the individual sheets from the long glass ribbon at first caused great difficulties, a solution suggesting itself and shown in Fig. 218, was to provide at each

partition one or two knife edges, a, side by side and of a height corresponding at least to the intended glass thickness; however, even the heaviest roll is not able to effect in this way a clean cut; there will always remain a thin glass crust on the knife edge, which congeals at once and then cracks or is crushed by the pressure of the roll. This causes the production of a dented cut, preventing the proper removal of the sheets and causing fissures and cracks in the sheet edges, and during the annealing in many cases causes the cracking of the sheet. Even simple cutting with the aid of a knife or with a cutting wheel running across the glass ribbon met with poor success. Immediately behind the roll the glass, indeed, is soft enough to be cut in this way; the cutting edges, however, will meet and stick together again, so that the proper and safe removal of the sheets is uncertain. Even if the edges should not stick, the sheet cut off would have to be separated somewhat from the edge of the next sheet in order to pass it safely, a rather difficult arrangement.

It was therefore decided to cut out a small strip, of the width of the table clearance, as suggested by the U. S. A. patent specification 1,105,610, 1,114,098 and 1,175,116. This strip then lay on the segment, filling the gap and after the passing of the roll automatically fell down with the former, so that the corresponding edge of the cut off glass sheet was free. Figs. 219 — 221 show the dropping knives, which were tried out in these tests. Over each table gap was hung one of these knives moving in guides d, and immediately after the passing of the roll and the escaping of the segment e, it descended. The real knives f, consisted of two elastic blades forming a U section, the width of which was greater than the width of the gap. These blades produced a very clean and crackfree cut along the steel edges g of the table. At the ends of these blades, catchers h were fixed, which penetrated into the recesses i of the gaps and thus ensured the proper introduction of the knives. A good cut was also obtained with circular knives of R. Holfig, as shown in Figs. 222 and 223, which were moved across the table with the aid of an electrically driven winch. The knives in this case were loaded with a weight and in returning were automatically lifted for protection against undue wear.

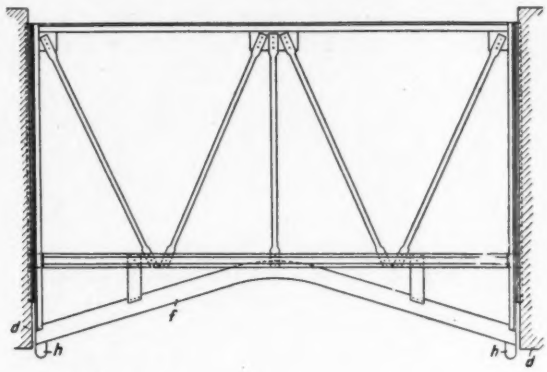

FIG. 220

FIG. 219

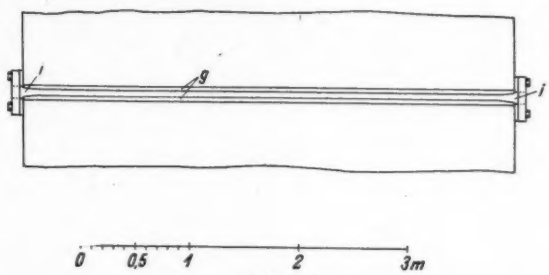

FIG. 221

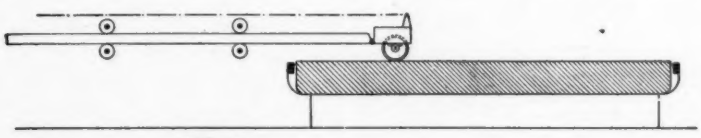

FIG. 222

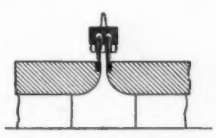

FIG. 223

(To be continued)

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Reference to the contents of earlier issues of THE GLASS INDUSTRY can be found in THE INDUSTRIAL ARTS INDEX in many Public and Technical Libraries.

Danger in the Use of Ammonium Sulphate

The use of ammonium sulphate has been recently recommended in glass batches, mainly as an accelerator of the reactions.

I find that its use is attended with complications in many instances, and it should not be employed without competent advice and adequate experimenting on a small scale.

The principal complication arises in the matter of color. I find that its use in chrome bearing glasses pushes the color from the yellow to the green more emphatically than any other chemical of my acquaintance.

Another technologist reports that it completely upsets the tint of a colored glass.

F. C. Flint reports that it has a disastrous effect on selenium.

It does not necessarily follow that its effect is always bad; it may be useful for specific purposes, and for obtaining certain colors. The point is that it must not be recklessly used as a refining or accelerating agent without considering its other actions.

This is just a note of warning; a more detailed account may be given later. F. W. PRESTON.

Conquering Silicosis

Silicosis, a disease caused by small particles of rock dust penetrating the lung tissue, occurs in many industries, but is especially prevalent in hard rock mining, granite cutting and sand blasting. In 1929, the *Journal of Industrial Hygiene* reported a study which showed that, of more than 200 rock drillers, 57 per cent had contracted silicosis and 9 per cent were tubercular.

The Metropolitan's Industrial Health Service has conducted studies of silicosis in the Picher, Okla., region, in cooperation with the U. S. Bureau of Mines; and in Manhattan, in cooperation with the State Department of Labor and the Harvard School of Public Health. Recently, on the site of the Metropolitan's new building in New York City, a Dust Eliminator, developed by George S. Kelley, engineer for George J. Atwill Foundation Company, was subjected to thorough tests. Miss Frances Perkins, New York State Industrial Commissioner said of this apparatus:

"I regard the Dust Eliminator . . . as a really great contribution to industrial safety. With the new device, experts who have been making extensive experimental tests declare that not more than 4 per cent of silica dust remains in the air which the workman breathes, and that is not enough to be harmful. The dust eliminating machine was constructed at the expense of the Metropolitan Life Insurance Company as a part of their program to further the general health of the population and probably will have the result of reducing mortality among a large class of workers."

Executives Service Bulletin, Sept., 1931, Metropolitan Life Insurance Co.

Welding with gases and electricity are relatively new processes but have a background of more than a decade of scientific research. In recent years such welding has been adapted to buildings and bridges. Noise elimination, economies and ease of application are a few reasons for adoption by the structural steel industry.—*Research Narratives.*

Glass In China

By WALTER BUCHLER

THE Chinese had no window glass of their own nor do they make any to-day. In early times they used nothing but paper or wooden shutters for their windows, which as a rule were very small. In many parts of the interior paper is still in universal use and as holes appear further layers of paper are stuck on. As to business, shops in China prefer to have their front open to the air to enable anybody and everybody to see what they offer for sale without necessarily having to enter and so feeling constrained to buy something. Thus, the majority of Chinese shops to-day still follow this practice and articles displayed in the front frequently protrude right up to the pavement. Where Chinese have windows in their homes they are usually small in size similar to what was used in England in olden days when old-fashioned bullions were in demand. At that time glass was made on the flat blown system causing a bull's-eye to appear in the centre of the piece, with the result that all windows could not be more than of a small size. Glass of this type is nowadays found in many Chinese houses where casements are small and means do not permit of anything bigger or better. This glass is imported principally from Belgium, and is very cheap.

CHINA PAINTED MIRRORS MADE FOR DECORATIVE PURPOSES, NOT FOR LOOKING INTO—SHANGHAI, CHINA

The rapid development of trade in the Treaty Ports of China has led to an important demand for all kinds of modern window and other glass for use in these cities. The advent of steel window frames has also promoted the use of better glass for buildings, both commercial and residential. Perhaps the most advanced of all and equal to any in the world is Shanghai, which is the most important and up-to-date city in the Far East. As one comes up the river the Bund presents a most imposing sight; practically all the larger buildings are fitted with steel frames and glass windows, the former supplied by Crittall, the latter by Pilkington, both of Great Britain.

With the construction of better buildings and the Westernization of the Chinese, window glass is becoming more and more used in China. Retail stores are using plate glass and not window glass, especially those selling silk and other valuable material, as a protection against the elements.

The Chinese like a lot of glass in their shops for show, just as they like to have as much electric light as their means permit. They make their own showcases, counters, and shelves and these are cut and polished locally. There is a demand for wired glass, which is used in the mills and other industrial undertakings for fire protection. The Chinese are very fond of highly ornamental figured glass which they use in their homes when requiring privacy. It is also found in Chinese restaurants where every table is accommodated in a private room screened off with panels of figured glass in different colors. This glass is nowadays seldom used in Europe, as architects and builders avoid it owing to the figuring on the glass retaining dust, but here the actual ornamentation is liked so much that this disadvantage is overlooked.

None is so fond of having mirrors in the home as is the Chinese, rich or poor. Nowadays there are mirrors made to suit all pockets. The biggest trade is in small mirrors, measuring 4x6 and 8x12 inches. The Chinese hang them up on the wall, the larger ones being painted on the surface with flowers, dragons, and other typically Chinese designs. They are not there for regarding oneself in but entirely for decorative purposes. A custom very popular among the Chinese is to present to one another as wedding gifts or New Year presents a large mirror usually the size of a wardrobe 48x18 framed in gilt and with the Chinese lettering, which embodies the greeting or good wishes sandblasted on the surface of the glass. The very small mirrors are used by Chinese ladies as at home. The frames are made in China the plain glass being imported and then silvered and beveled by Chinese workmen expert in this craft. They import the necessary ingredients for silvering as well as small beveling machines from the Continent for hand beveling the glass. As the glass comes in clear it is imperative that a good quality should be supplied, as the action of the silvering multiplies any defect which reacts on the vision and gives a distorted reflection. There are numerous imitations of plate-glass imported into China in great quantities and these cater for the cheap retail trade. These are not really plate glass, as the latter must be ground and polished on both surfaces to give them a true finish, whereas these imitations are only a thick common window glass

with a surface untouched by any grinding or polishing process.

The average Chinese dealer is very suspicious of any small change that might take place in the appearance of the case or packing. For instance, Pilkingtons used to pack, their glass shipped to the China market with brown paper, but of recent years they changed it to a green "dri-pack" paper in order to protect the surface of the glass from the humidity encountered during the voyage through the tropics. And though the quality and the glass were indentical with all previous supplies, there was at first trouble with Chinese dealers owing to the change in the color of the paper, as they imagined that there must be some change also in the quality. This shows the conservatism of the Chinese and their abhorrence of any change.

Methods of transport differ here considerably from Western practice. Large cases of plate glass, which would in Europe or America be transported by truck or crane, are moved in China by dozens of coolies with the aid of bamboo poles and nothing else. This is a very safe and at the same time very cheap way of transporting large show window plates. No very large polished plate glass is imported into the interior of China, as there are no show window displays to any great extent, except perhaps in one or two cities such as Hankow.

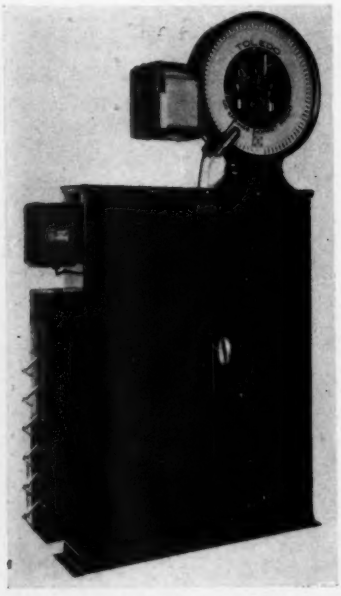
Various dockyards in Hongkong and Shanghai import all sizes of one inch thick porthole glass for liners which encounter typhoons at certain times of the year (August and September) on the China coast, especially in the neighborhood of Hongkong. The glass trade is in the hands of Chinese dealers who specialize in window glass, mirrors, and other glass, obtaining their supplies from local importers.

An Automatic Batch Controlling Device

With the new automatic batching equipment, recently developed by Toledo Precision Devices, Inc., the batching of glassmaking and similar materials is reduced, it is stated, to a simple cycle of lever and button operations which can be performed by unskilled labor. This new assembly consisting of a Toledo scale equipped with a photoelectric tube, a lever system and a set of beams, makes the batching operations practically automatic, and at the same time achieves greater accuracy and reduces the time required.

The tank or hopper where the batching takes place is mounted on a special assembly on the scale platform. There is a set of beams, one for each ingredient which enters the mix. These beams are regulated by a system of hand levers on one side of the scale. Buttons control the starting of the flow of materials. When the desired weight has been placed on the scale, the photoelectric relay stops the flow. Attached to the head of the scale is a graphic recorder. This provides a checking record for every ingredient which enters the tank, and hence a constant guard against mistakes.

This equipment is simple to operate. Each beam is set for the correct amount of the ingredients which are to enter the mix. Once the beams are thus set, the following operations are practically automatic. The operator turns down the first handle, which throws the beam for the first ingredient into the lever system. He then walks on the other side of the scale and presses the button for that ingredient. This starts the flow of material. While walking from one side of the scale to the other, the indicator has sufficient time to come to equilibrium. The first ingredient starts to flow into the tank, and the indicator starts to return to zero.



NEW AUTOMATIC BATCH FEEDING DEVICE

While this ingredient is flowing into the tank, a light beside the button burns brightly. When the necessary amount has entered the tank, this light dims. Hence, by glancing at these lights the operator can immediately tell how many ingredients have already been put into the mix, and whether any ingredient is flowing into the tank at that instant. The same operation is followed for each ingredient until the batching is complete. Afterwards inspectors can check each batch by the graphic record which is provided.

It is claimed that this equipment sets new standards in this field by providing absolute accuracy, reducing labor costs and setting new standards of speed. Full details can be obtained on application to Toledo Precision Devices, Inc.

Some Investigations of Glass at the Bureau of Standards

The development of a purple color in certain glasses resulting from exposure to sunlight led to the making of a few glasses to see if the change could be ascribed to any single constituent in the glass. This phase of the work has not been finished, but one sample of glass containing manganese was exposed to the light from a quartz mercury arc lamp and the color became appreciably darker. Similar samples containing iron were made, but the tests are not yet complete. In this connection a sample was made from very pure materials without the addition of any coloring material and its ultra-violet transmission at 302 m/u was greater than 60 per cent for a thickness of 2.6 mm. (0.10 inch), whereas similar samples containing small amounts of either reduced or oxidized iron showed practically no transmission at the same wave length.

DEVITRIFICATION

In the course of work on the effect of heat treatment of glass it was observed that certain borosilicate glasses of the Pyrex type devitrified in an apparently variable manner, as was indicated by their properties after treatment. In studying this condition samples of the glass were heated at temperatures between 625 and 850°C. At the lower temperatures employed devitrification proceeded slowly, but at 800° a considerable portion of the glass was opaque after three days' heating. Longer treatments at this temperature caused the entire piece of glass to devitrify and the kind of crystals which developed depended greatly on the length of the heat treatment. Cristobalite accompanied by small amounts of quartz and tridymite were present after the shortest treatments and after the longer treatments the amount of cristobalite was largely reduced or it had entirely disappeared and the amount of tridymite was greatly increased. The presence of cristobalite, quartz and tridymite was shown by petrographic, X-ray, heating curve, and expansivity methods.

Recent Patents

NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

Complete copies of U. S. Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C., Price 10c each

METHOD OF FEEDING MOLTEN GLASS. U. S. 1,853,002. Apr. 5, 1932. George E. Howard, Butler, Pa., assignor to Hartford-Empire Company, Hartford, Conn. Filed 6/16/27.

METHOD OF STRENGTHENING FROSTED GLASS ARTICLES. U. S. 1,852,840. Apr. 5, 1932. Kitsuzo Fuwa and Toshizo Okugawa, Tokyo, Japan, assignors to General Electric Company. Filed 9/30/27.

PROCESS AND APPARATUS FOR FORMING MOLTEN GLASS. U. S. 1,852,719. Apr. 5, 1932. George E. Howard, Butler, Pa., assignor to Hartford-Empire Company, Hartford, Conn. Filed 3/15/29.

GLASSWARE FORMING MACHINE. U. S. 1,852,570. Apr. 5, 1932. Victor E. Hofmann, Toledo, Ohio, assignor to Owens-Illinois Glass Company, Toledo, Ohio. Filed 9/17/28.

GLASS GATHERING. U. S. 1,852,329. Apr. 5, 1932. Frank O'Neill, Toledo, Ohio. Filed 3/19/27.

MULTIPLE GLASS CUTTING MACHINE. U. S. 1,852,310. Apr. 5, 1932. Chester F. Klages and Norman H. Klages, Pittsburgh, Pa., assignors to G. W. Klages & Son, Inc., Pittsburgh, Pa. Filed 8/24/25.

MULTIPLE GLASS CUTTING MACHINE. U. S. 1,852,311. Apr. 5, 1932. Chester F. Klages and Norman H. Klages, Pittsburgh, Pa., assignors to G. W. Klages & Son, Inc., Pittsburgh, Pa. Original application filed 8/24/25. Divided and this application filed 4/3/29.

METHOD OF AND APPARATUS FOR FEEDING MOLTEN GLASS. U. S. 1,852,218. Apr. 5, 1932. Karl E. Peiler, West Hartford, Conn., assignor to Hartford-Empire Company, Hartford, Conn. Filed 11/7/25.

PROCESS AND APPARATUS FOR PRODUCING SHAPED MOLD CHARGES OF MOLTEN GLASS. U. S. 1,853,003. Apr. 5, 1932. George E. Howard, Butler, Pa., assignor to Hartford-Empire Company, Hartford, Conn. Filed 11/1/28.

GLASSWARE BLOWING MECHANISM. U. S. 1,853,861. Apr. 12, 1932. Boswell F. Hatch, West Hartford, and Arthur B. Butterfield, Hartford, Conn., assignors to Hartford-Empire Company, Hartford, Conn. Filed 3/13/28.

GLASS JAR. 86,730. Apr. 12, 1932. Harry R. McDonald, Dunkirk, Ind., assignor to Hart Glass Mfg. Co., Dunkirk, Ind. Filed 1/16/32.

GLASS CUTTING APPARATUS. U. S. 1,853,298. Apr. 12, 1932. Robert P. Callard and John H. Moller, Charleston, W. Va., assignors to Libbey-Owens-Ford Glass Co., Toledo, Ohio. Original application filed 10/20/25. Divided and this application filed 1/13/26.

SHEET GLASS SCORING DEVICE. U. S. 1,853,498. Apr. 12, 1932. Charles E. Bliven, Charleston, W. Va., assignor to Libbey-Owens-Ford Glass Company, Toledo, O. Filed 11/13/25.

GLASS CUTTING APPARATUS. U. S. 1,853,505. Apr. 12, 1932. Robert P. Callard and John H. Moller, Charleston, W. Va., assignors to Libbey-Owens-Ford Glass Company, Toledo, Ohio. Filed 10/20/25.

APPARATUS FOR AND METHOD OF FEEDING MOLTEN GLASS. U. S. 1,853,842 and 1,853,843. Apr. 12, 1932. Lloyd G. Bates, West Hartford, Conn., and Frank E. Haskell, Holyoke, Mass., assignors to Hartford-Empire Company, Hartford, Conn. Filed 10/12/29.

SHEET GLASS SURFACING MEANS. U. S. 1,854,384. April 19, 1932. James C. Blair, Toledo, O., assignor to Libbey-Owens-Ford Glass Company. Filed 3/21/27.

METHOD AND APPARATUS FOR SECURING GLASS SHEETS UPON SUPPORTING TABLES. U. S. 1,854,399. Apr. 19, 1932. John L. Drake, Toledo, O., assignor to Libby-Owens-Ford Glass Co., Toledo, O. Filed 6/27/29.

GLASSWARE ANNEALING LEER. U. S. 1,854,452. Apr. 19, 1932. Albert N. Cramer, Toledo, O., assignor to Owens-Illinois Glass Company, Toledo, O. Filed 4/12/27.

GLASSWARE HANDLING APPARATUS. U. S. 1,854,453. Apr. 19, 1932. Albert N. Cramer, Toledo, O., assignor to Owens-Illinois Glass Co., Toledo, O. Filed 10/22/28.

APPARATUS FOR PRODUCING HOLLOW GLASSWARE. U. S. 1,854,471. Apr. 19, 1932. Victor E. Hofmann, Toledo, O., assignor to Owens-Illinois Glass Company, Toledo, O. Filed 5/15/28.

SHEET GLASS SURFACING APPARATUS. U. S. 1,854,493. Apr. 19, 1932. Erik G. Stahle, Pittsburgh, Pa., assignor to Libbey-Owens-Ford Glass Company, Toledo, O. Filed 10/28/26.

GLASS SURFACING APPARATUS. U. S. 1,854,507. Apr. 19, 1932. John L. Drake, Toledo, O., assignor to Libbey-Owens-Ford Glass Company, Toledo, O. Filed 5/4/28.

SHEET GLASS DRAWING MEANS. U. S. 1,854,506. Apr. 19, 1932. John L. Drake, Toledo, O., assignor to Libbey-Owens-Ford Glass Co., Toledo, O. Filed 2/6/28.

GLASS MELTING FURNACE. U. S. 1,854,505. Apr. 19, 1932. John L. Drake, Toledo, O., assignor to Libbey-Owens-Ford Glass Company, Toledo, O. Filed 3/2/27.

MEANS FOR MOUNTING PLATE GLASS. U. S. 1,854,545. Apr. 19, 1932. John C. Gipe and Joseph P. Crowley, Toledo, O., assignors to Libbey-Owens-Ford Glass Co., Toledo, O. Filed 6/27/29.

APPARATUS FOR CUTTING FLAT GLASS. U. S. 1,855,078. Apr. 19, 1932. Robert Charles Williamson, Doncaster, England, assignor to Pilkington Brothers Limited, Liverpool, England. Filed 8/8/31 and in Great Britain 8/11/30.

SHEET GLASS PRODUCING APPARATUS. U. S. 1,822,724. Sept. 8, 1931. Leopold Mambourg, Lancaster, O., assignor to Libbey-Owens-Ford Glass Company, Toledo, O. Filed 9/20/26.

GLASS ROLLING APPARATUS PARTICULARLY APPLICABLE TO THE PRODUCTION OF CONTINUOUS GLASS STRIPS. U. S. 1,822,027. Sept. 8, 1931. Ernest Bristow Le Mare, St. Helens, England, assignor to Pilkington Brothers, Limited, Liverpool, England. Filed 12/18/30 and in Great Britain 8/28/29.

APPARATUS FOR SPINNING GLASS FILAMENTS. U. S. 1,821,937. Sept. 8, 1931. Paul O. E. Friedrich, Millville, N. J., assignor to Gould Storage Battery Corp., Depew, N. Y. Filed 1/25/27. The combination with a mechanism comprising a pair of spaced upright headers, a plurality of glass rods supported by one of said headers, means on said other header for rotating said rods at substantially the same speed, means on one of said headers and movable therewith for uniformly heating said rods and a spinning wheel for drawing glass threads from each of said rods, said wheel being covered on its cylindrical face with a fabric whereby the glass threads may be caused to adhere thereto.

GLASS JAR. U. S. 85,067. Sept. 8, 1931. Walter B. Sterrett, Muncie, Ind., assignor to Ball Brothers Company. Filed 6/11/31.

GLASSWARE TRANSFER DEVICE. U. S. 1,823,574. Sept. 15, 1931. George E. Rowe, West Hartford, Conn., assignor to Hartford-Empire Company, Hartford, Conn. Filed 10/15/29.

TWO TABLE GLASS FORMING MACHINE. U. S. 1,823,123. Sept. 15, 1931. Karl E. Peiler, West Hartford, Conn., assignor to Hartford-Empire Company, Hartford, Conn. Filed 1/18/29.

SHEET GLASS ROLLING APPARATUS. U. S. 1,822,959. Sept. 15, 1931. John L. Drake, Toledo, O., assignor to Libbey-Owens-Ford Glass Company, Toledo, O. Filed 8/30/26.

OPTICAL PYROMETER. U. S. 1,825,229. Sept. 29, 1931. Rudolf Hase, Hanover, Germany. Filed 12/9/26 and in Germany 2/26/26.

LAMINATED GLASS AND METHOD OF MAKING THE SAME. Nov. 10, 1931. William Henry Moss, Cumberland, Md., assignor to Celanese Corporation of America, a corporation of Delaware. Filed 10/20/28.

Preparation of Feldspathic Flux for Glass and Porcelain

A process for the preparation of feldspathic flux for porcelain, glass, etc., is covered by patent 1,855,115 issued April 19, 1932, to C. H. Peddrick, Jr., vice-president of the United Feldspar Corp. of New York and others and assigned to that corporation. The following abstracts are made from the patent specifications.

It is well known ("Non-Metallic Minerals" by Ladoo, 1925, pages 212-213) that theoretically pure feldspars are alumino silicates of potassium, sodium, calcium and rarely barium, and that such theoretically pure feldspars of any type are not found in commercial quantities. Feldspathic fluxes for porcelain, glass, enamel, etc., vary widely in their content of one or another kind of pure feldspar, or content of different kinds, and also in their content of quartz or silica, alkali, or other ingredient. The desires and necessities of users of feldspathic fluxes vary widely, and it is the object of this invention to enable feldspathic flux to be prepared at the mill of uniform, standard composition which can be repeated at will, instead of leaving the customer to buy, subject to acceptance or rejection, feldspars of specified grade, such as No. 1, No. 2, or No. 3. (Ladoo, page 220) but of unknown and varying composition, and make up his own flux with other materials after analyzing each shipment of each grade of feldspar he may have ordered.

Feldspar, which is a constituent of most of the flux used, is generally sold without any positive knowledge of its chemical contents, the rock being simply mined and crushed. Consequently, each consumer must mix with the feldspathic rock which they purchase additional quartz, alkali or pure feldspar, or such other ingredient as may be necessary, to give the proper mixture, and even under these circumstances there is no definite means of determining the proper proportions until the finished material is turned out of the kilns, this often resulting in a loss of the whole batch.

The present process provides for the preparation at the feldspar mill of a definite flux composition suitable for the requirements of the particular customer, and one which is ready to be used by the consumer without the addition of quartz, alkali or pure feldspar, or any other ingredient, to bring the flux up to the desired chemical content.

In carrying out the invention there is provided a series of bins having delivery spouts at their bottom ends. Along the tops of these bins longitudinally is a trackway carrying a reversible traveling conveyor of the endless belt type. At each end of the conveyor a receiving bin is hung, arranged to empty into a suitable spout. The operation of the conveyor and the other parts of the equipment is briefly described in the patent specifications. After passing through the apparatus, the material is discharged from a pulverizer and deposited onto a conveyor belt which feeds the material between the poles of a high intensity magnetic separator system. This system is employed for removing the mica particles from the feldspar.

This statement would appear to be erroneous for mica is generally known as a dielectric and non-magnetic material; however, it has been discovered that the mica in a great many feldspar mines, or deposits, has a metallic mineral, such as iron, adhering to it and is known as black mica, biotite, or iron mica which is, to some extent, magnetic and can be removed as stated.

In the mining of feldspar certain parts of the mine give rock which differs in feldspar content and kind from that in other parts of the mine, or in other mines. Some is deficient in feldspar of one or another kind, or other ingredient. Other is deficient in quartz, alkali or other ingredient.

In the operation of this process the rock from a certain mine or from a given part of the mine is loaded into the crusher and there crushed. From thence it passes onto the elevator and onto the conveyor which has been so positioned as to deliver the rock to a specific bin. Thus when such a bin has been filled, or when rock is brought from other parts of the mine, or from other mines, the conveyor is shifted so as to deliver to another bin. Rock from a certain mine or from a part of the mine is kept in a different bin or bins as the case may be.

When it is desired to make any certain mixture, the samples which are collected in the pans during the delivery of the rock to the respective bins are analyzed and by proper calculation a definite weight of rock from one of the bins is fed to the hopper and this may be followed by rock from some other of the bins of mined rock, while, if desired, a pure feldspar or pure quartz or other ingredient, such as alkali, may be mixed with the contents of the hopper.

The hopper is moved to feed the materials to the bin connected with the pulverizer. During the pulverizing operation they are mixed so that the product from the pulverizer is of known composition as regards its feldspar, quartz, alkali and other contents, and consequently is adapted in its content for the specific purposes desired.

By this invention a simple and efficient process is provided whereby the diverse feldspars occurring either in the same or different mines can be compounded at the mill into feldspathic flux of desired composition, and whereby such flux can be duplicated or modified as desired.

The Italian Glass Situation

The general situation in Italy does not present any bettering or recovery. In the white glass industry the situation is considered critical, as many establishments in order to keep their operatives at work as much as possible find their warehouse crowded with unsold products comprising a good portion of the production of the past eight weeks. Orders of real importance are scarce, and are assumed at prices that hardly cover the production costs. In the plate glass industry the sales are small, while in the bottle industry the only busily occupied producers are those using highly perfected mechanical means. The provisions for the near future are pessimistic with many of these.

In the industry of Venetian glasses, and especially of those of Murano, the crisis is also acute. Foreign competition is more strongly felt than ever in the bead articles (conteries), not only abroad, but also in Italy itself. Even the producers of artistic glasses suffer enormously through the World's economical crisis, that strongly restricts the consumption of all articles of luxury. In the various ceramic works the situation maintains itself without much change, being always better than that of the glass industry; very well engaged are the porcelain producers that supply the electrotechnical industry. In the enameled iron industry the situation is so depressed that a recovery is not expected for quite a long time. —*From Our Correspondent*

Making Diamonds from Glass Sand

Reprinted from Gleason's Pictorial Drawing-Room Companion, 1854

One of the most curious sights in Paris, or indeed in the world, is afforded by a visit to the vast atelier of M. Bourguingnon, situated at Barriero de Trone, where the whole process of transforming a few grains of dirty, heavy looking sand into a diamond of the purest water is daily going on, with the avowed purpose of deceiving everybody but the buyer. The sand employed, and upon which everything depends, is found in the forest of Fontainebleau, and enjoys so great a reputation in the trade, that large quantities are exported. The coloring matter for emeralds, rubies and sapphires is entirely mineral, and has been brought to high perfection by M. Bourguingnon. He maintains in constant employment about a hundred workmen, besides a number of women and young girls, whose business it is to polish the colored stones and line the false pearls with fish scales and wax. The scales of the rosche and dace are chiefly employed for the purpose, and form a considerable source of profit to the fishermen of the Seine in the environs of Corbeil, who bring them in large quantities during the season. They must be stripped from the fish while living, or the glistening which we admire so much in the real pearl cannot be imitated.—*Boston Post.*

And Now We Make Diamonds at College

The most up-to-date news concerning the art of making artificial diamonds was announced last month by Professor Ralph H. McKee, of the department of chemical engineering, Columbia University, who told of the successful completion of tests carried on under his instructions for the manufacture of diamonds larger than any heretofore produced artificially.

The Glass World and What It Is Doing

News of the Industry

Glass Blackboards for Schools

For many years there has been a definite need for a blackboard that has all of the good characteristics of natural slate, besides additional characteristics and properties which are lacking in the natural product. Finally, after a prolonged period of research, the New York Silicate Book Slate Company has perfected and patented a glass blackboard which will be known as Seloc Glass Blackboard.

It is made of black plate glass with a suspended abrasive uniformly dispersed throughout the glass while molten. Not just a top surface treatment that wears smooth and slippery, but a blackboard that is perfect surface all the way through from back to front. Experimental tests equivalent to one hundred years wear have left Seloc Glass Blackboards as good as new.

Educational experts claim that black plate glass makes the ideal board—non-fading, obtainable in almost any lengths, easily installed, practically indestructible, and susceptible of a perfect finish.

The makers state that this blackboard will never have to be refinished, stained or darkened, and guarantee it for the life of the school.

The weight of this board is the same as natural slate, and installing into frames entails less labor on account of longer lengths, having fewer joints to match. The glass boards are made 5/8" thick, in sheets 3 to 4½ feet wide, and lengths up to 8 feet.

The cost is said to be slightly higher than that of natural slate.

Owens-Illinois Glass Company Earnings

Owens-Illinois Glass Company earned $2,508,276 for the twelve months ended March 31, 1932. These earnings are equivalent, after providing for yearly dividends on the Company's preferred stock, to $2.20 per share on the 922,173 shares of common stock outstanding. For the preceding twelve months' period ended March 31, 1931, the Company's net earnings were $2,620,111, or equivalent to $2.32 per share on the common stock after provision for preferred dividends.

Net manufacturing profits were slightly larger than for the previous year, and a further ten percent reduction in general overhead expenses was made. However, there was a decline in the Company's income from miscellaneous sources and this, together with some extraordinary deductions from earnings to reduce Government and Federal Land Bank Bonds to market values at December 31, 1931, and to provide reserves against possible losses on cash in closed banks, made earnings for the period somewhat less than for the year previous.

Dividends for the year were paid at the rate of $6.00 per share on the $8,000,000 of outstanding preferred stock and $2.00 per share on the common. Quarterly dividends of $1.50 per share on the preferred stock and 50¢ per share on the common have been declared payable July 1st and May 15th respectively.

A statement released by the company, on April 25, pointing out that it is in an exceptionally favorable position to benefit from any change in the status of prohibition was disclosed at the company's annual meeting. It was indicated that several of the company's plants, which are now idle, have been kept in readiness for immediate operation; that many additional workers would be employed, and that an increase in the company's sales and net earnings would result.

Changes in R. & H. Executive Staff

At the directors' meeting of the Roessler & Hasslacher Chemical Company, Incorporated, manufacturers of R. & H. chemicals, held on March 28th in New York City, Dr. H. R. Carveth, president of the company, announced his retirement as president and director of the company and as a director of The E. I. du Pont de Nemours & Company, Incorporated, of which R. & H. is a subsidiary. Dr. M. J. Brown, vice-president and a director of R. & H., also resigned all positions with the company. Charles K. Davis, of New York, was elected president to succeed Dr. Carveth. He will also be general manager of the company. Dr. E. A. Rykenboer, formerly vice-president of the company, will be vice-president and assistant general manager. The other officers are: Chairman of the Board, W. F. Harrington; vice-president and secretary, Colby Dill; vice-president, Milton Kutz; treasurer, Albert Frankel; assistant treasurer, August Heuser; assistant secretary, M. D. Fisher; assistant secretary, E. A. Howard; assistant secretary, J. Carlisle Swaim.

Dr. Carveth's retirement ends almost 26 years of service with R. & H., during which time the company grew to be one of the largest manufacturers of chemical specialties in this country. His retirement was not entirely unexpected for he had made known his wishes to be relieved of executive responsibilities in order to devote more time to his increased personal interests.

Charles K. Davis, the new R. & H. president, is a well-known figure in the chemical industry, having been president of The Viscoloid Company, another du Pont subsidiary. Mr. Davis has had a wide experience as a chemical engineer, not only with the du Pont organization, but with many other companies. Before joining du Pont, he was with The Aluminum Company of America, American Steel Foundries, American Smelting and Refining Company, and The Braden Copper Company in Chile.

Dr. E. A. Rykenboer, vice-president and assistant general manager, graduated from the University of Rochester in 1912 and received his Ph.D. degree from the University of Michigan in 1917. The same year he became research chemist at the R. & H. Niagara plant, later becoming senior chemist. In 1930, he was made general superintendent of the Niagara Falls plant. In 1930, he was elected a director, and in 1931, a vice-president of the company.

Tiffany Studios File Petition

The Tiffany Studios, established in New York many years ago by Louis Comfort Tiffany whose fame as an artist and worker in stained glass became world wide, have filed a petition in bankruptcy. It was signed by Robert Ashmead, treasurer of the Tiffany organization and cited liabilities of $481,595 and assets of $315,907 listed largely as accounts receivable. The principal creditor is Mr. Tiffany to whom there are owing notes and other credits to the amount of $223,356. The Bankers Trust Company holds notes for $125,000 and a resident of Philadelphia holds a disputed claim of $13,957. Among the assets is a large amount of unfinished work, including memorials and other works of art. The Studios financial difficulties have been caused, it is said, by the business depression.

Few American artists are better known than Mr. Tiffany, whose decorative designs and artistic products, especially in glass, have always been popular. Among his productions was an entirely new type of vari-colored glass designated as Tiffany Favrile. In a chapel at Mr. Tiffany's summer home, Laurelton, L. I., there is a beautiful Tiffany altar, one of his famous mosaic productions, which was taken there many years ago from the Cathedral of St. John the Divine, where the atmospheric conditions were unsatisfactory. This mosaic consists of 150,000 squares of glass. Mother of pearl medallions are included, also topazes, sapphires, pearls and carrara marble are utilized in various ways in the design of the altar. Another of his glass mosaics which was highly praised at the time of its erection and which is in the Chapel of the Angels at St. Michaels Episcopal Church.

The Tiffany Studios were organized in 1878 as the Louis Comfort Tiffany Associated Artists, which later became the Tiffany Glass Company and in 1892 was re-named the Tiffany Glass and Decorating Company. There is no doubt that a very large number of specimens of artistic glass work done or inspired by Mr. Tiffany could be found in thousands of the better class American homes as well as to quite an extent in foreign countries.

Burgess Battery Company of Chicago have moved their Eastern headquarters to 202 E. 44th Street, N. Y. This includes the battery, mountainaire, acoustic, and radiovisor divisions and the C. F. Burgess Laboratories, Inc. and Burgess-Parr Company. The new telephone number is VAnderbilt 3-3525.

Libbey-Owens-Ford Glass Company Report

The fifteenth annual report of the Libbey-Owens-Ford Glass Company issued at Toledo, O., April 13, 1932 covering the fiscal year ending December 31, 1931 showed current assets consisting of cash, government securities, Federal Land Bank bonds, notes, trade acceptances and accounts receivable, allowance for doubtful accounts and inventory, $7,316,397; investment in and amount due from controlled company, less allowance for shrinkage in value $566,413; investment in and amount due from affiliated companies less allowance for shrinkage to present value $1,677,698; claims against banks in liquidation less allowance for possible loss, plus deposits, mortgages, miscellaneous notes and accounts receivable and treasury stock and gold notes $593,194. Stock subscriptions, employees stock plan, payable in cash $531,812; manufacturing properties, employees dwellings, etc., buildings, machinery, equipment, land, less reduction in book value December 31, 1931 charged to paid in surplus, and with allowance for depreciation and reserve for future revaluation $22,434,589; gas properties, equity $977,043; patents, licenses, etc. $3,433,320 offset by an equal allowance for amortization to December 31, 1930, and addition charged to paid in surplus December 31, 1931, deferred items of furnace materials, machine parts, etc., unexpired insurance premiums, work orders, prepaid taxes, supplies, etc. $530,388; total $34,627,538.

Liabilities, current accounts payable, unpaid payrolls, accrued county taxes, royalties, etc., $901,038; 5% convertible serial gold notes authorized and issued $9,000,000. Reserves for rebuilding furnaces and general contingencies plus possible inventory shrinkage $1,528,709; common stock without par value (3,500,000 shares authorized), 2,335,342 shares issued including 85,090 shares subscribed under stock plan, 360,000 unissued shares reserved for gold note conversion; stated capital plus surplus December 31, 1931, $23,197,789; total liabilities $34,627,538. The income and expense account shows a net manufacturing profit for the year ended December 31, 1931 of $642,448, a total manufacturing profit and other income, $376,276, total expense and other deductions $2,116,-920, net loss $1,098,195.

The Libbey-Owens-Ford Glass Company's report for the first quarter of 1932 shows a net profit of $44,230 compared with a net loss in the corresponding quarter of 1931 of $188,072.

Pittsburgh Plate Glass Company's Annual Report

The annual report of the Pittsburgh Plate Glass Company to stockholders for the year ending December 31, 1931 issued March 12 by Clarence M. Brown, chairman of the Board of Directors and H. S. Wherrett, president of the Pittsburgh Plate Glass Company shows that the consumption of plate glass continued its downward trend and was approximately 20% below that of 1930. The quantity of foreign glass which came into the country showed a corresponding decline. The outlook for the current year is not encouraging. New building is at a very low point, with little prospect of immediate improvement, and the demand for automobiles probably will not exceed that of last year. Safety plate glass (Duplate) is growing in popularity, and since it requires in its composition two pieces of plate glass, offers the best prospect for increased production in 1932.

The Company's plant at Ford City, Pa., replacing the Charleroi operation, was completed in July, 1931. It is now successfully manufacturing at this plant, Carrara glass, both white and black, heavy polished plate glass, spectacle glass and special glasses, all of higher qualities and at lower costs than were possible by the old process.

Gross earnings for the year 1931 were $6,165,848. Net profit after deducting $3,964,101 for depreciation, obsolescence and depletion, amounted to $2,201,746. Total expenditures for additions and improvements, including new plant at Ford City, new warehouses, and new equipment for the chemical division, aggregated $5,504,177.56 making a net increase in plant investment, after deducting depreciation, obsolescence and depletion, of $1,532,490.96

Fourteen makes of motor cars are now being glazed in whole or in part with Duplate safety glass. The company's Long Island City, New York warehouse was closed and the unit moved to Jay, Water and Plymouth Streets, Brooklyn, New York where it is housed in a modern and well equipped building.

The Quertinmont Glass Company, Fairchance, Pa., is operating with a substantial force under the authority of the receivers, C. D. Swanson, G. L. Whipkey and A. D. Mayer.

Laclede Christy Mullite Refractories

Laclede-Christy, St. Louis, Mo., recently announced the development, after long research and experiment, of Laclede Mullite Super-Refractories. In connection with this material the statement is made that it possesses properties that have never before been combined in a refractory of low cost. It is claimed that in a water dip spalling test carried out according to United States government practice where high grade fire brick usually fails at less than 30 dips, Laclede mullite passed 130 dips without failure before the test was discontinued. Another claim made for this material is that in the A. S. T. M. re-heat test Laclede mullite showed absolutely no permanent shrinkage or expansion. It is also stated to be resistant to slag action and carries unusually high loads at elevated temperatures. Laclede-Christy has also developed a special Mullite-base cement, Setskold C-7, to insure that the joints of Laclede mullite brick construction will be as refractory as the brick itself and equally resistant to slag attack.

Strike at Polish Glassworks

All is not well in the glass manufacturing trade in Poland. At the Glasshouse Piotrkowska Rektyfikacja, Piotskowie Tryb, hundreds of workers, in an effort to enforce their demand for increased wages locked themselves in the factory and announced their intention of staying there without working until the desired conditions are complied with. Nor will they allow anyone else to work. They defy both the police and the factory management, amuse themselves as best they can and live on food which is brought to them by their relatives. It is said that the government authorities are making an effort to bring the strike to an end.

British Tariff on Glass in Effect

At midnight, April 25, the British Government Import Duty Advisory Committee's tariff of 20% went into effect. Included in the many items subjected to this tariff are most kinds of pottery and glassware.

March Production of Polished Plate Glass

The total production of polished plate glass by the member Companies of the Association for the month of March, 1932, was 4,414,-464 sq. ft. as compared to 6,426,905 sq. ft. produced by the same Companies in the preceding month, February 1932, and 8,673,473 sq. ft. produced by the Association members in the corresponding month last year, March 1931. These figures, compiled by P. A. Hughes, Secretary of the Plate Glass Manufacturers of America, show a total production of 16,340,980 sq. ft. by these Companies for the first quarter of 1932, as compared to 13,557,097 sq. ft. produced in the last quarter of 1931, and 22,516,878 sq. ft. produced in the first quarter of 1931.

The Ford Motor Company announced late in April that their River Rouge plant has passed the 1,000-a-day production mark and will increase the output during May to 2,000 a day. The schedule calls for the production of 500,000 cars, two-thirds of which it is said will be V-8 models. According to the report over 250,000 advance orders have not yet been filled. Nearly 85,000 employes are at work and additional workers will be recalled during the coming month. The Edgewater, N. J. plant and 32 other assembly plants will go on full production as fast as possible. It was stated that these branches have 60,000 four cylinder engines in stock and a large supply of other parts.

The Brock Glass Company, Ltd. of Santa Ana, Cal., recently known as the Consolidated Factories, Ltd. have added equipment for making locks, window fasteners, cupboard catches, etc. to their glass plant. A new 50 ton tank has been completed from which 5-gallon water bottles and jars will be made. The company's plant No. 2 will be dismantled and all production done at the Santa Fe Avenue works. Before this plant came into the company's possession it was operated by another concern for a couple of years on five gallon bottles. Bert Rutter, a glass man well known throughout the Coast trade, is still located on Balboa Island.

Eastern Division of the National Glass Distributors Association is meeting at New York as we go to press, April 28, on call of Secretary Carl E. Doerr.

The New York State Department of Labor has issued a series of leaflets No. 2-A on industrial hygiene, giving the results of special studies on the health hazards of workers whose occupations require the use of chemicals which may cause poisoning. Among the industries using such chemicals is glassmaking, where cases of selenium, lead and arsenical poisoning are not rare and where silicosis caused by the dust from silica sand sometimes occurs, not only in connection with the handling of sand but also in sand blasting and the manufacture of abrasive powders. Arsenic poisoning occurs by breathing dust or vapors of arsenic compounds or taking such compounds into the mouth. This poisoning may enter the body through the skin if the skin is broken. These infections are prevalent also in pottery making and vitreous enameling factories. Recommended methods for controlling the silicosis and other hazards are given in the leaflets, copies of which may be obtained from State Industrial Commissioner Frances Perkins, Department of Labor, 80 Center Street, New York.

The Vitro-Agate Company is reported as having been organized and incorporated in West Virginia with a capital of $25,000 to manufacture glass. The organizers are named as George W. Johnson, Anna W. Stephenson, and Myrtle Smith, all of Parkersburg, W. Va.

J. C. Brady Passes Away

J. C. Brady, chairman of the board of directors of The Hazel-Atlas Glass Company, Wheeling, W. Va., died after a brief illness, on April 25th, just as this issue is going to press.

Born in Wheeling, September 23, 1851, Mr. Brady later was instrumental in organizing and building up the present corporation which operates plants at various centers.

New Plate Glass Industry Incorporated

The Eckenrode Plate Glass Corporation has been incorporated under the laws of the State of Washington to engage in the plate glass manufacturing industry.

Coming Meetings

The American Refractories Institute will hold its Annual Spring Meeting in the William Penn Hotel, Pittsburgh, Pa., on Wednesday, May 18.

Back Numbers

Any subscriber having a bound volume of the first two issues of THE GLASS INDUSTRY, November and December, 1920, and the twelve issues of 1921, or in possession of a complete set of these fourteen issues and who is willing to dispose of them will be put in touch with a glass man who desires to obtain those numbers. Address, THE GLASS INDUSTRY.

Statement of the Ownership, Management, Circulation, etc., required by the Act of Congress of August 24, 1912, of THE GLASS INDUSTRY, published monthly, at New York, N. Y., for April 1, 1932. State of New York, County of New York—ss. Before me, a Notary Public, in and for the State and County aforesaid, personally appeared G. W. Cooper, who, having been duly sworn according to law, deposes and says that he is the managing editor of THE GLASS INDUSTRY, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Glass Industry Publishing Co., Inc., 24 W. 40th St., New York; editors, D. E. Sharp and F. W. Preston; managing editor, G. W. Cooper, 24 W. 40th St., New York; business manager, G. W. Cooper, 24 W. 40th St., New York.

2. That the owners are (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent or more of the total amount of stock): Glass Industry Publishing Co., Inc., 24 W. 40th St., New York; G. W. Cooper, 24 W. 40th St., New York; R. D. Proctor, 24 W. 40th St., New York.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are (If there are none, so state): None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting is given: also that the said two paragraphs contain statements, embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him. G. W. COOPER, Managing Editor. Sworn to and subscribed before me this 30th day of March, 1932. [Seal] TERESA DABROWSKI, Notary Public. (My commission expires March 30, 1932.)

Performance TALKS

185 and 193 Day Runs for These 2 L-C Pots

Laclede-Christy Pots certainly do stand up! The illustration above shows that. It is an actual photograph of two of our "pot service record cards," which we furnish to every customer.

Whether *you* get 193 day runs from the Laclede-Christy Pots *you* buy—or better, or worse—depends largely upon your individual plant conditions and practices. But rest assured that whatever these conditions are, Laclede-Christy Pots will give you the very *maximum* of service and performance.

Let your next pots be "Laclede-Christy."

LACLEDE-CHRISTY, ST. LOUIS, U. S. A.

P-4

LACLEDE-CHRISTY POTS

Current Prices of Glass-Making Materials

April 21, 1932

Quotations furnished by various producers, manufacturers and dealers.

Acid	Carlots	Less Carlots
Citric (dom.) lb.	..	.32
Hydrochloric (HCl) 20° tanks, per 100 lb	..	1.10
Hydrofluoric (HF) 60% (lead carboy) lb.	..	.13½
52% and 48% lb.	.10	.10-.11½
Nitric (HNO_3) 38° carboy ext. Per 100 lb.	5.50	..
Sulphuric (H_2SO_4) 66° tank cars ton	15.50	..
Tartaric lb.	..	.24½
Alconol, denatured gal.	..	..
Aluminum hydrate (Al $(OH)_3$) lb.	.04½-.05	.05½-.06
Aluminum oxide (Al_2O_3) lb.	..	.07
Ammonium bifluoride (NH_4) FHF lb.	..	.15½
Ammonia water (NH_4OH) 26° drums lb.		
Antimony, metallic (Sb) lb.	.02½	.02¾
Antimony oxide (Sb_2O_3) lb.	..	.09½
Antimony sulphide (Sb_2S_3) lb.	..	.08½
Arsenic trioxide (As_2O_3) (dense white), 99% lb.	.04	.14 .04½
Barium carbonate ($BaCO_3$), Crude. (Witherite) 90%, 99% through 200 mesh ton	47.00	..
90% through 100 mesh ton	44.00	..
Barium hydrate ($Ba(OH)_2$) lb.	..	.05¼
Barium mixture, glassmaker's, f.o.b. St. Louis ton	25.00	..
Barium nitrate ($Ba(NO_3)_2$) lb.	..	.07¼
Barium selenite ($BaSeO_3$) lb.	..	..
Barium sulphate, in bags ton	19.00	24.00
Barium sulphate, glassmaker's, carlots, bulk, f.o.b. shipping point, ton	15.00-16.00	18.00
Bone ash cariots, lb	.06	.06½
Borax ($Na_2B_4O_7 10H_2O$) lb.	..	.02¼-.02¾
Granulated lb	.02-.02½	.02¼-.02¾
Powdered lb.	.02¼-.02¾	..
Boric acid (H_2BO_3) lb	.04¼-.05¼	..
Cadmium sulphide (CdS)—		
Red lb.	..	.65-.90
Orange lb.	..	.60-1.10
Yellow lb.	..	1.30-1.50
Chromium oxide (Cr_2O_3) lb.	..	.20
Cobalt oxide (Co_2O_3)		
In bbls. lb.	..	1.25-1.35
In 10 lb. tins lb.	..	1.35
Copper oxide		
Red (Cu_2O) lb.	..	.25
Black (CuO) lb.	..	.17-.19
Black prepared lb.	..	.22
Cryolite ($Na_3Al F_6$) Natural Greenland Kryolith) lb.	.09	.09¼
Synthetic (Artificial) lb.	..	.09½
Epsom salts ($MgSO_4$) (imported) Per 100 lb.	..	1.15-1.20
*Feldspar—		
100 mesh ton	11.50-17.50	12.00-18.00
80 mesh ton	11.00-11.50	13.00
40 mesh ton	10.75-11.00	12.00
20 mesh ton	9.50- 9.75	10.00
Fluorspar (CaF_2) domestic, ground, 96-98% (max SiO_2, 2½%)		
Bulk, carloads, f.o.b. mines ton	30.00	..
In bags or barrels ton	34.00	39.00
Imported ton	30.00-31.00	33.00-37.00
Formaldehyde lb	..	.07
Graphite (C) lb	..	.04-.07
Iron oxide—		
Red (Fe_2O_3) lb	..	.0425
Black (FeO) lb	.04½	..
Kaolin (f.o.b. mine) ton	8.00-9.00	..
English, lump, f.o.b. New York ton	14.50-25.00	24.50-30.00

*Spot Shipments.

Kryolith (see Cryolite)	Carlots	Less Carlots
Lead chromate ($PbCrO_4$) lb.	..	.30
Lead oxide (Pb_3O_4) (red lead) lb.	.0550	.0675
Litharge (PbO) lb.	.0450	.0575
Lime—		
Hydrated ($Ca(OH)_2$) (in paper sacks) ton	5.50	..
Burnt (CaO) ground, in bulk ton	5.00	..
Burnt, ground, in paper sacks ton	7.00	..
Burnt, ground, in 280 lb. bbls. Per bbl	2.15	..
Limestone ($CaCO_3$)	1.50-2.50	..
Magnesia (MgO)—		
Calcined, heavy (in bbls.) lb	.06	.07
light (in bbls.) lb.	..	.23
extra light (in bbls.) lb.	..	.37
Magnesium carbonate ($MgCO_3$) lb.	.06	.10
Manganese 85% (MnO_2) lb.	.03	.03
Nickel oxide (Ni_2O_3), black— for nickel content lb	..	.35
Nickel monoxide (NiO), green— for nickel content lb	..	.35
Plaster of Paris, bags ton	21.00	23.00-29.00
Potassium bichromate ($K_2Cr_2O_7$)—		
Crystals lb.	.09	.09¼
Ground lb.	.11	.12
Potassium carbonate—94-96% lb.	.0555	.0555
Calcined (K_2CO_3) 96-98% lb.	.06¼	.07
Hydrated 80-85% lb.	.05¾	.06¼
Potassium chromate (K_2CrO_4) lb.	..	.25
Potassium hydrate (KOH) (caustic potash) lb	.07⅛	.08
Potassium nitrate (KNO_3) (gran.) lb.	..	.06-.06¼
Potassium permanganate ($KMnO_4$) lb.	.16	17
Powdered blue lb.	..	1.35
Rochelle salts, bbls. lb.	..	.16
Rouge lb.	..	..
Rutile (TiO_2) powdered, 95% lb.	.15-.20	.20-.25
Salt cake, glassmakers (Na_2SO_4) ton	22.00	..
Selenium (Se) lb	..	1.70
Silver nitrate (AgNO.) (100 oz.) per oz	..	.22¾
Soda ash (Na_2CO_3) dense, 58%—		
Bulk, on contract Flat per 100 lb	1.05	..
In barrels Per 100 lb	1.38	1.90-2.13
In bags Per 100 lb.	1.17½	1.72½-1.92½
Spot orders .025 per 100 lbs. higher	..	..
Sodium bichromate ($Na_2Cr_2O_7$) lb	.07	.07½
Sodium hydrate (NaOH) (caustic soda) Solid Per 100 lb	2.50	..
Sodium nitrate ($NaNO_3$)—		
Refined (gran.) in bbls. lb.	..	..
95 per cent. Per 100 lb.	1.67-177	1.72-1.82
Sodium selenite (Na_2SeO_3) lb		2.00
Sodium fluosilicate (Na_2SiF_6) lb.	.05½	.06
Sodium uranate (Na_2UO_4) Yellow or Orange lb.	..	1.50-1.55
Sulphur (S)—		
Flowers, in bbls. Per 100 lb	3.45	3.80-4.00
Flowers, in bags Per 100 lb	3.10	3.45-3.65
Flour, heavy in bbls. Per 100 lb	2.85	3.20-3.40
Tin chloride ($SnCl_2$) (crystals) lb.	.37½	.39
Tin oxide (SnO_2) in bbls. lb.	.28	.29½
Uranium oxide (UO_2) (black, 96% U_3O_8) 100 lb. lots. Black lb.	..	2.75
Yellow lb	..	1.50
Zinc oxide (ZnO) lb.	.08½	..
American process, Bags lb.	.05¾	.06
Zircon		
Granular (Milled .005-.02c higher)	.07	.07½-.08
Crude, Gran. (Milled .005-.02c higher)	.03½	.04-.05

Monthly Summary of United States Foreign Commerce in Glass

EXPORTS

Corrected to March 24, 1932.

	February 1931 Quantity	February 1931 Value	February 1932 Quantity	February 1932 Value	Two Months Ending February 1931 Quantity	Two Months Ending February 1931 Value	Two Months Ending February 1932 Quantity	Two Months Ending February 1932 Value
Glass and glass products (Total)	.....	$634,231	.....	$401,326	.....	$1.281,746	.....	$773,985
Plate and window glass—								
Window glass, common, box 50 sq. ft.	516	2,387	194	1,221	1,329	6,762	376	2,095
Plate glass, unsilvered, sq. ft.	406,513	122,786	464,958	130,520	780,549	229,010	832,139	222,165
Other window and plate glass lbs.	268,137	27,029	108,121	13,248	673,464	59,572	294,040	34,059
Glass containers (bottles, vials and jars)	.....	143,543	.....	78,603	.....	353,698	.....	158,325
Table glassware, plain	.....	76,119	.....	37,217	.....	144,025	.....	69,307
Table and other glassware, cut or engraved	.....	4,452	.....	2,706	.....	7,901	.....	7,967
Lamp chimneys and lantern globes lbs.	.....	8,716	.....	5,263	.....	22,040	.....	9,687
Globes and shades for lighting fixtures lbs.	.....	27,567	.....	19,179	.....	72,786	.....	35,234
Chemical glassware lbs.	9,872	11.147	6,705	7.747	24,658	26,372	15,604	15,637
Electrical glassware, except for lighting lbs.	139,241	9,875	122,637	4,442	245,288	20,639	267,714	10,491
Other glassware	.....	200,610	.....	101,180	.....	338,941	.....	209,018

IMPORTS

Corrected to March 24, 1932.

Glass and glass products	.....	$469,527	.....	$296,563	.....	$964,736	.....	$623,389
Cylinder, crown, and sheet—								
Plain dut. lb.	1,200.354	40.049	211,633	8 928	1,978,314	72,769	368,997	14,847
Bent, beveled, colored, etc. dut. lb.	187.830	20,938	81,339	14,120	325.532	41,444	168,156	28,501
Plate glass dut. sq. ft.	416,327	126,678	194,912	33,112	807,758	227,062	459,854	78,492
Glass mirrors	4	4	52	867	192	387	482	1,370
Rolled, cylinder, crown, and sheet glass, ground, obscured, bent, beveled, colored, etc.	.....	5,336	.....	2.247	.....	9,518	.....	31.155
Laminated glass and manufactures, and plated glass	.....	838	.....	3.634	.....	1.296	.....	6,332
Bottles, vials, jars, and other containers	.....	36,178	.....	31,097	.....	80,757	.....	46.221
Scientific articles and utensils dut.	.....	24,533	.....	18 785	.....	55.251	.....	43,589
Tubes and rods dut.	.....	10,969	.....	4,197	.....	17,589	.....	9,834
Illuminating articles dut.	.....	26,447	.....	22,306	.....	67,288	.....	43,470
Blown glass articles—								
Bulbs for electric lamps, without filament dut.	1,092,164	10,480	1,291,738	10.138	2,572,072	23,920	2,218,781	17,569
Other blown glass articles dut.	.....	105,308	.....	84,003	.....	228,895	.....	176,845
Pressed glass articles	.....	12,200	.....	7,058	.....	21,804	.....	19,707
Other glassware	.....	49,569	.....	56,071	.....	116,756	.....	105,457